U. S. Geological Survey

HQ - Disciplines

Regions

Geology Water, Biology, Geography Western, Central, Eastern

Science Programs - $'s

Earthquake Hazards

Volcano Hazards

Landslide Hazards

Coastal and Marine Geology

Geologic Mapping

Mineral Resources

Energy Resources

Earth Surface Dynamics

Astrogeology

Geomagnetism

Geology teams - people

Western Earthquake Hazards

Volcano Hazards

Western Earth Surface Processes

Western Mineral Resources

Astrogeology

Western Coastal and Marine Geology

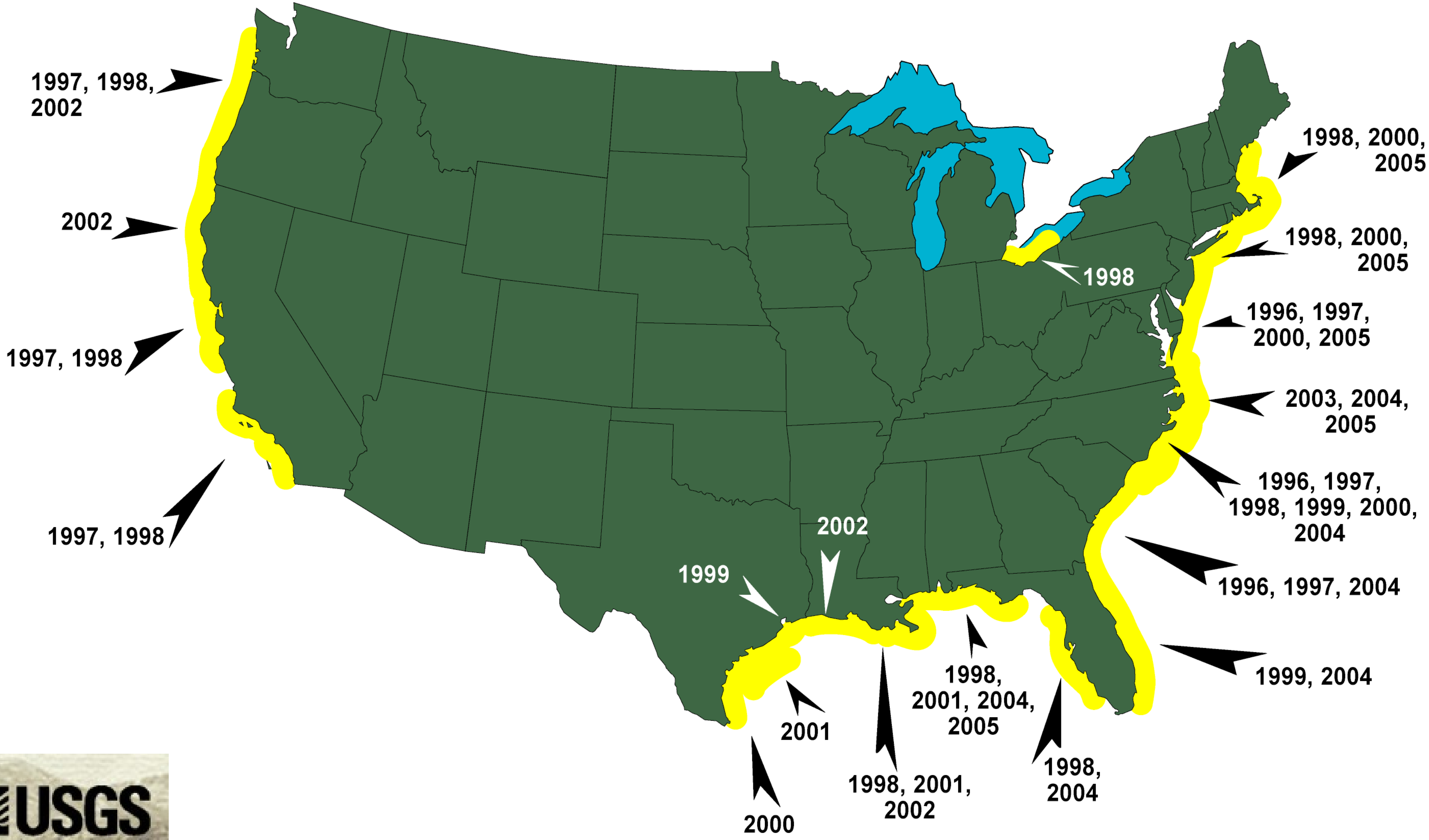
(~ 100 FTE, 1-3% of USGS)

Coastal and Marine Geology Program/Tea

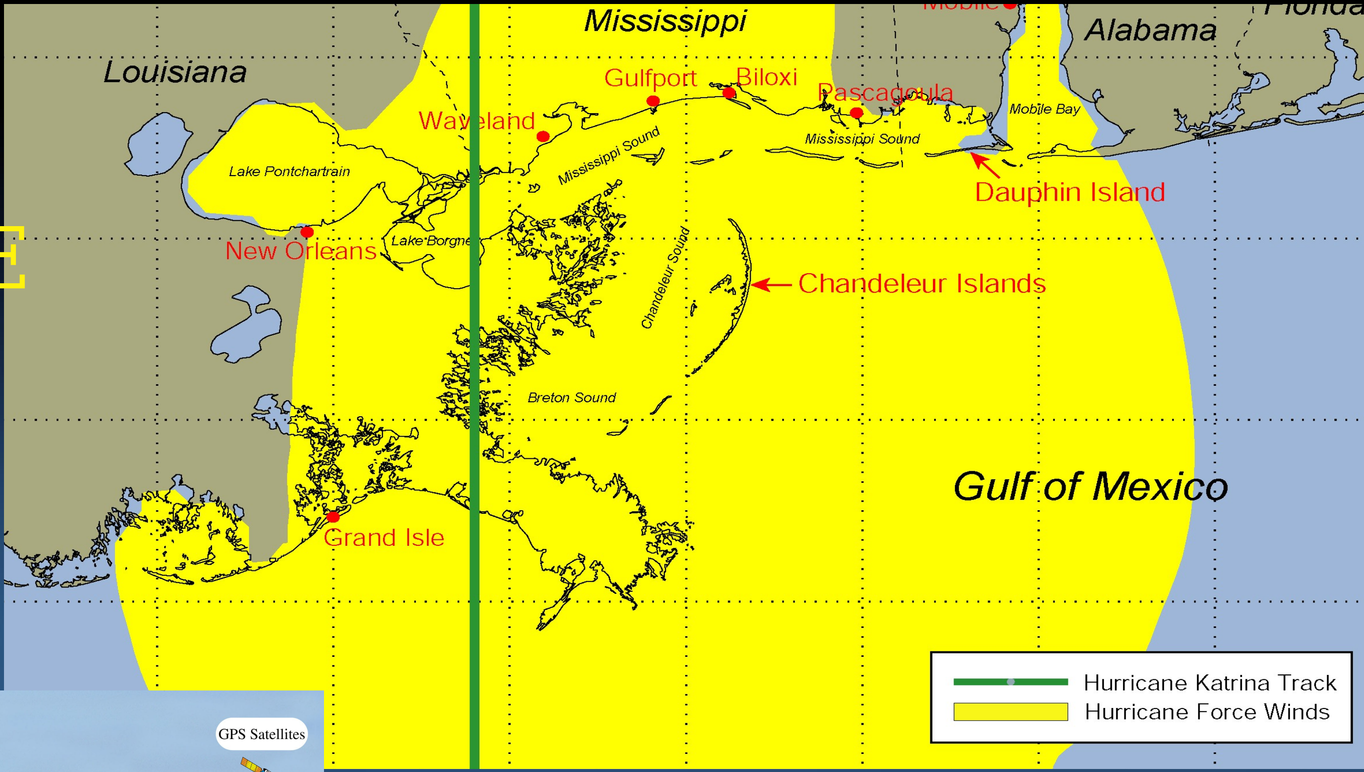
- Hazards - Coastal erosion, tsunamis, submarine slope stability and landslides, earthquakes, hazard assessment, modeling
- Environment - Seafloor and habitat mapping, ecosystem health and restoration, sediment and contaminant transport, sediment management, modeling, coastal groundwater
- Resources - Sand and aggregates, gas hydrates, marine minerals
- Information - Knowledge bank, data management, archiving, data rescue

Present USGS/ACE collaboration

NATIONAL COASTAL LIDAR COVERAGE: ACE, USGS, NASA, NOAA
Texas Bureau of Economic Geology

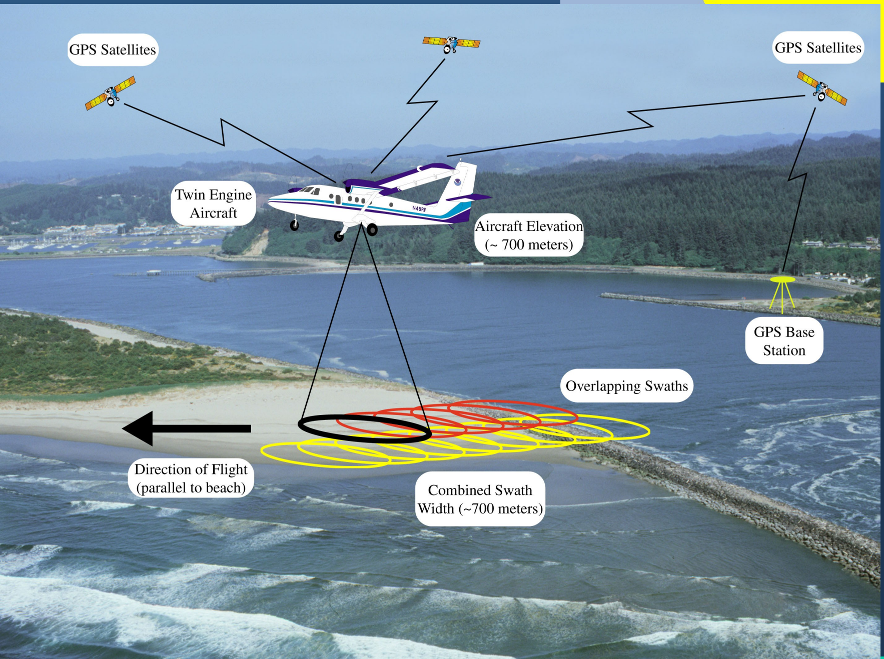

1997, 1998, 2002
2002
1997, 1998
1997, 1998
1998, 2000, 2005
1998
1998, 2000, 2005
1996, 1997, 2000, 2005
2003, 2004, 2005
1996, 1997, 1998, 1999, 2000, 2004
1996, 1997, 2004
1999, 2004
2002
1999
2001
2000
1998, 2001, 2002
1998, 2001, 2004, 2005
1998, 2004

STORM RESPONSE


Mississippi
Alabama
Louisiana
Gulfport
Biloxi
Pascagoula
Waveland
Mobile Bay
Mississippi Sound
Lake Pontchartrain
Mississippi Sound
Dauphin Island
New Orleans
Lake Borgne
Chandeleur Sound
Chandeleur Islands
Breton Sound
Gulf of Mexico
Grand Isle
Hurricane Katrina Track
Hurricane Force Winds

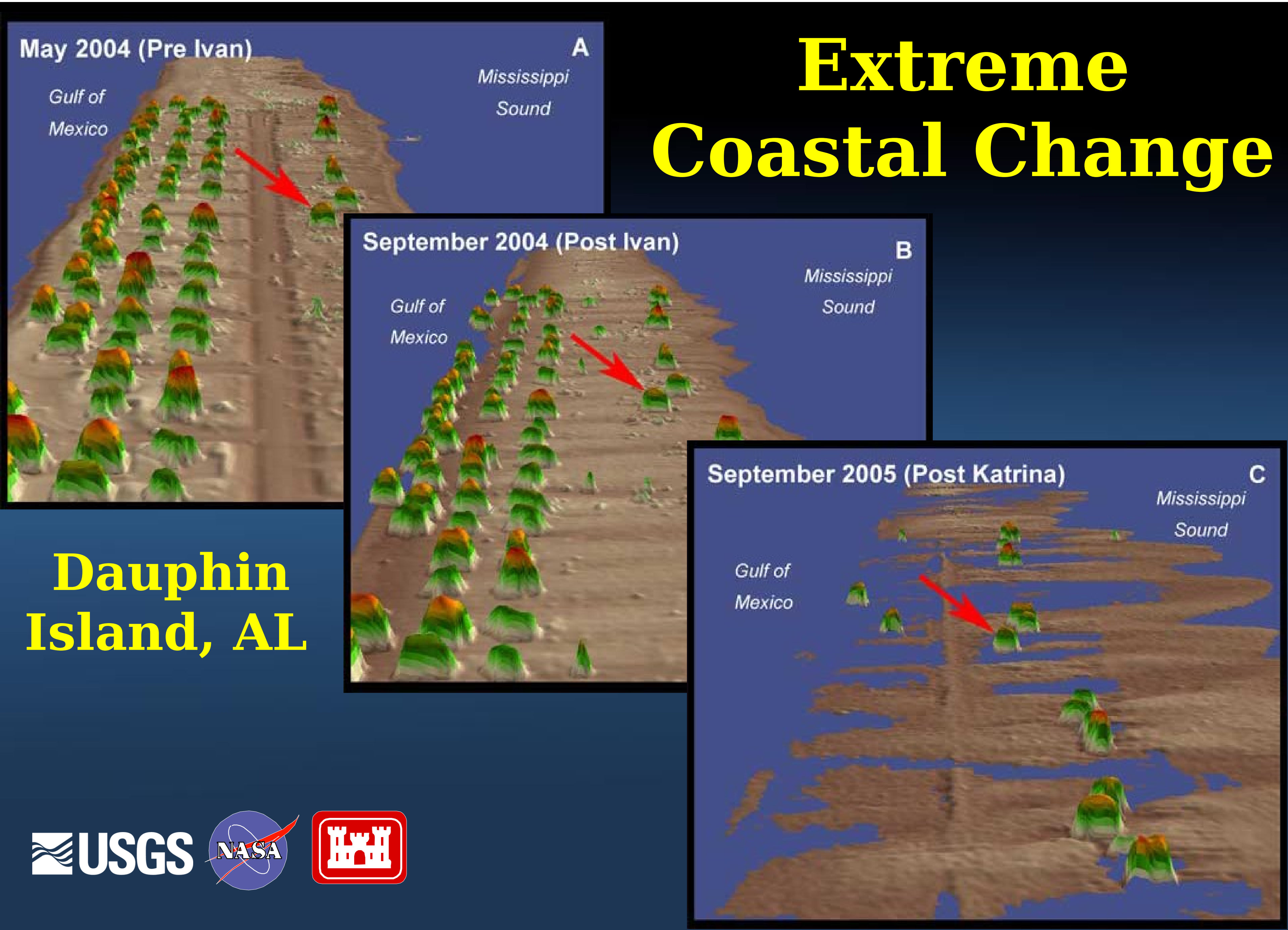
Hurricane force winds

Data from NOAA Hurricane Research Division


GPS Satellites
GPS Satellites
Twin Engine Aircraft
Aircraft Elevation (~ 700 meters)
GPS Base Station
Overlapping Swaths
Direction of Flight (parallel to beach)
Combined Swath Width (~700 meters)

Lidar topographic mapping

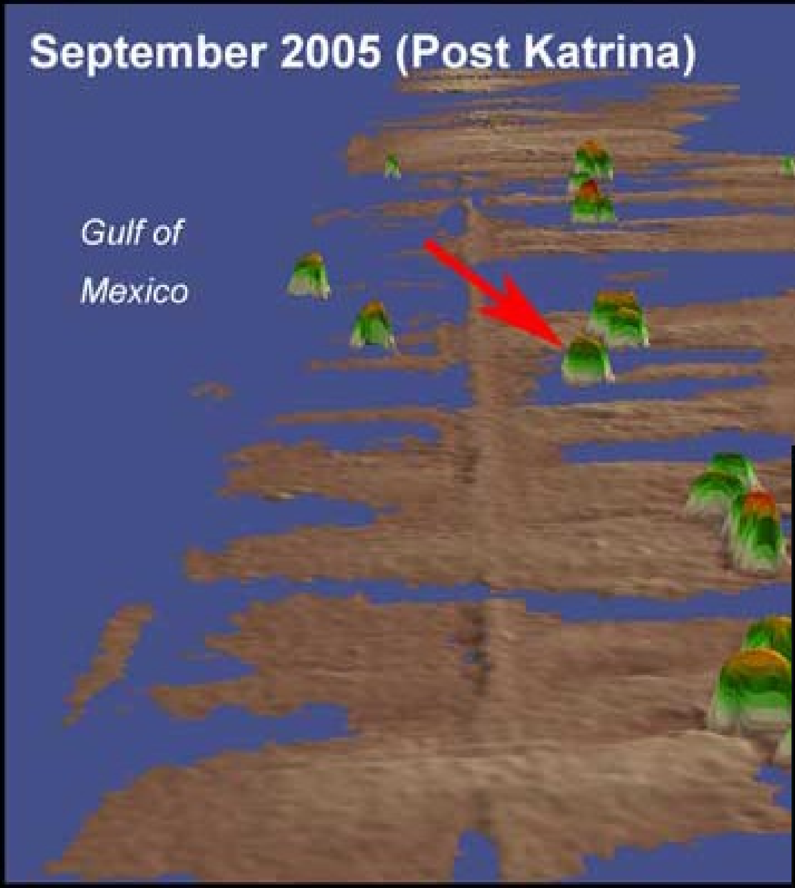
Extreme Coastal Change

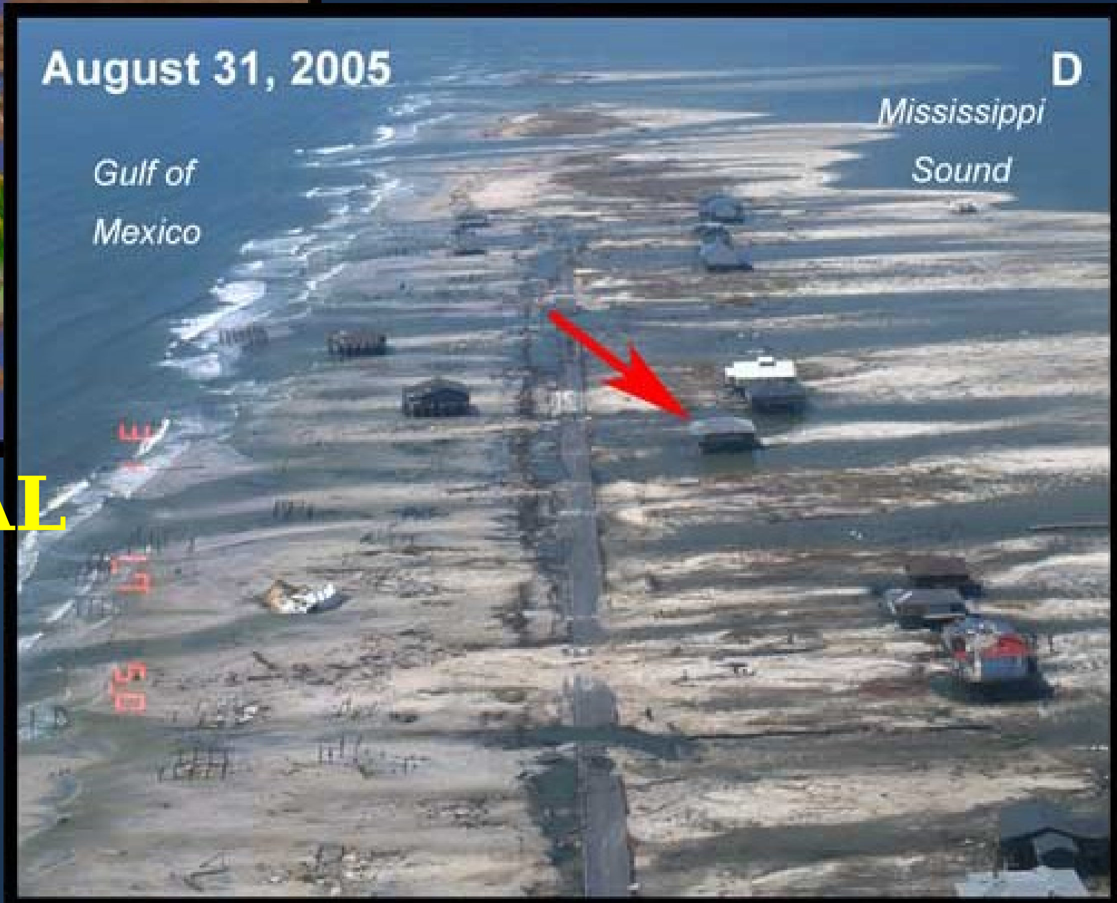

May 2004 (Pre Ivan)
A
Gulf of Mexico
Mississippi Sound
September 2004 (Post Ivan)
B
Gulf of Mexico
Mississippi Sound
September 2005 (Post Katrina)
C
Mississippi Sound
Gulf of Mexico

Dauphin Island, AL

USGS NASA

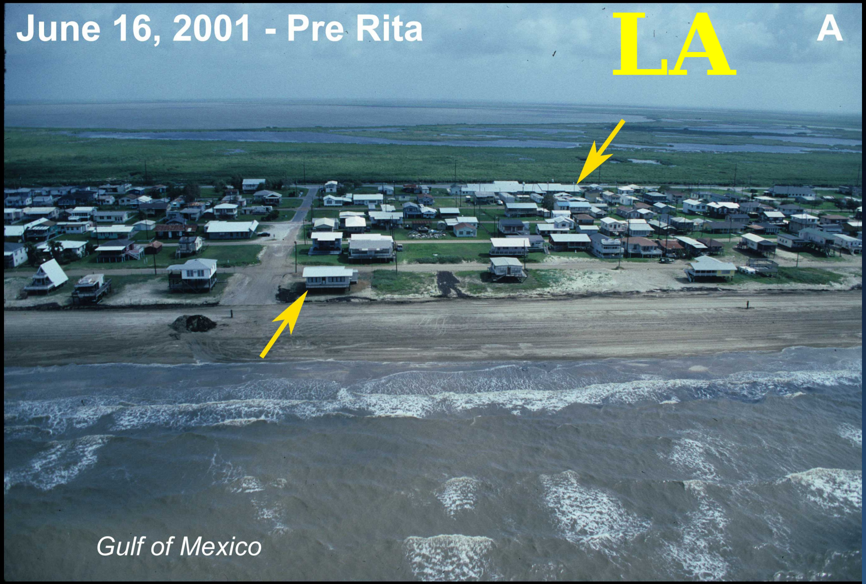
Post Katrin


September 2005 (Post Katrina)
C
Mississippi Sound
Gulf of Mexico


August 31, 2005
D
Mississippi Sound
Gulf of Mexico

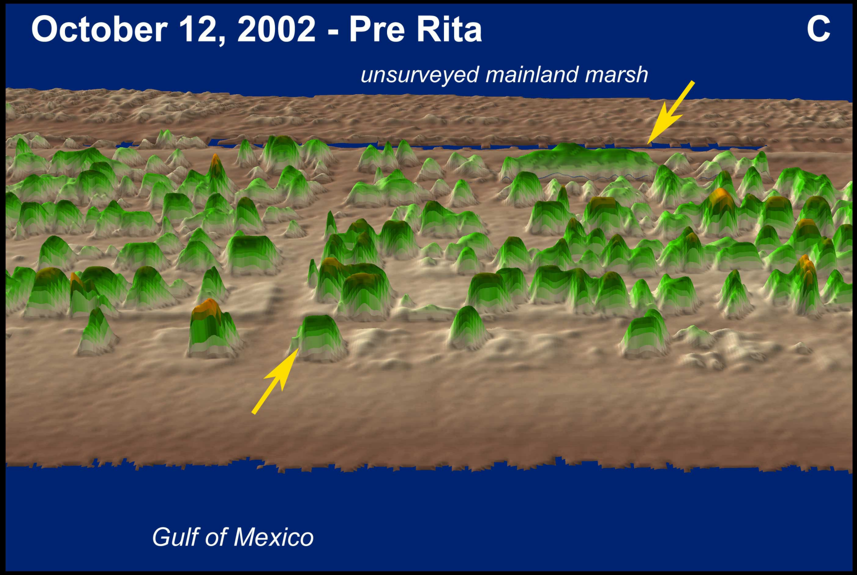
Dauphin Island, AL

Holly Beach, LA



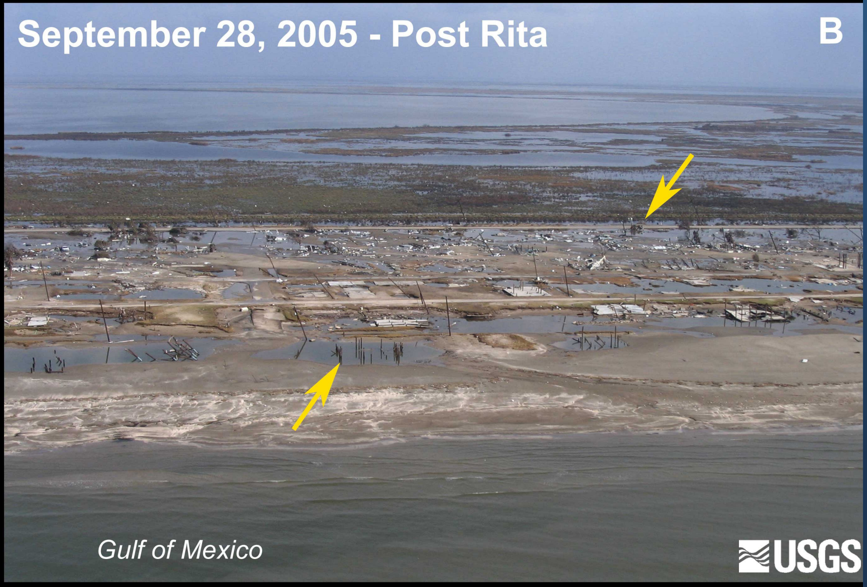
June 16, 2001 - Pre Rita

A
Gulf of Mexico



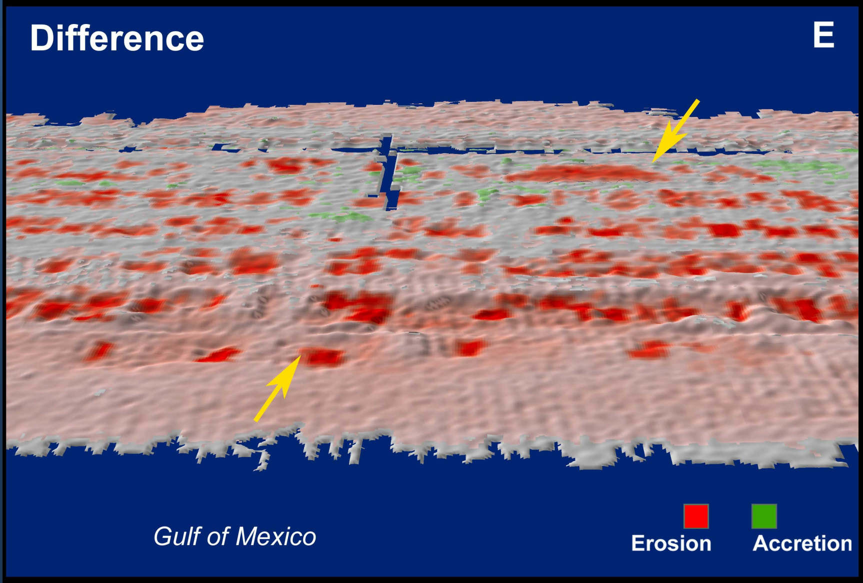
October 12, 2002 - Pre Rita

C
unsurveyed mainland marsh
Gulf of Mexico



September 28, 2005 - Post Rita

B
Gulf of Mexico
USGS



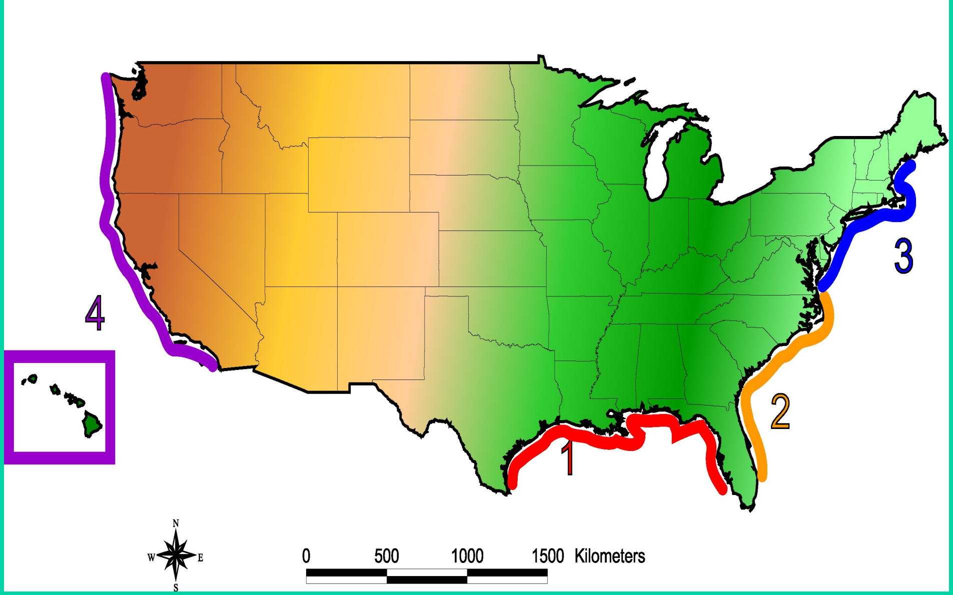
Difference

E
Gulf of Mexico
🟥 Erosion
🟩 Accretion

NATIONAL SHORELINE CHANGE ASSESSMEN

~ Objectives ~

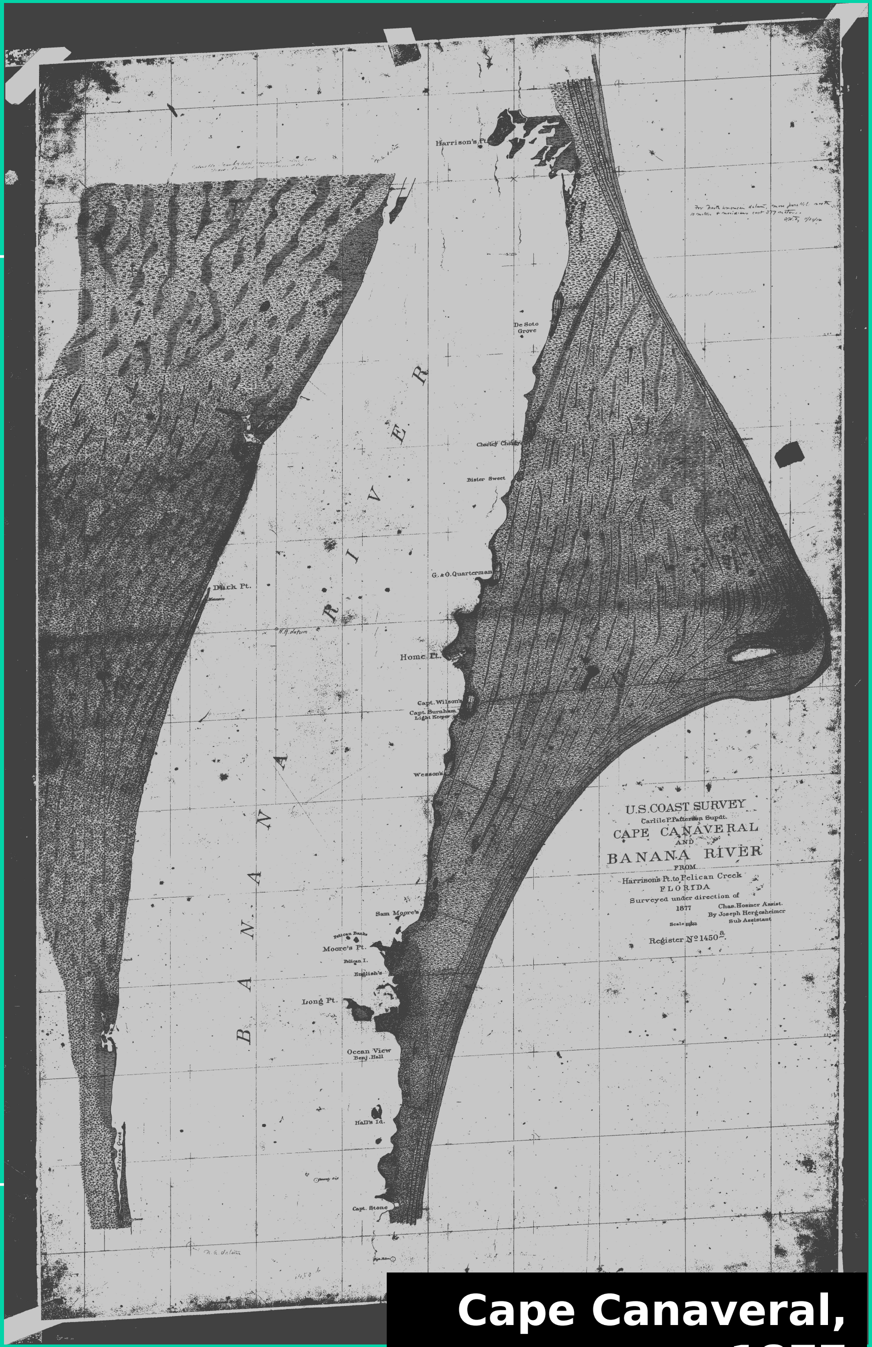
- Develop the next generation of assessment tools.
- Apply standard and uniform methods of shoreline change analysis.
- Establish procedures for future comparisons of shoreline position.
- Contribute to prediction of future coastal conditions.



4
3
2
1
N
W
E
S
0
500
1000
1500 Kilometers

Methods: Historical Shorelines

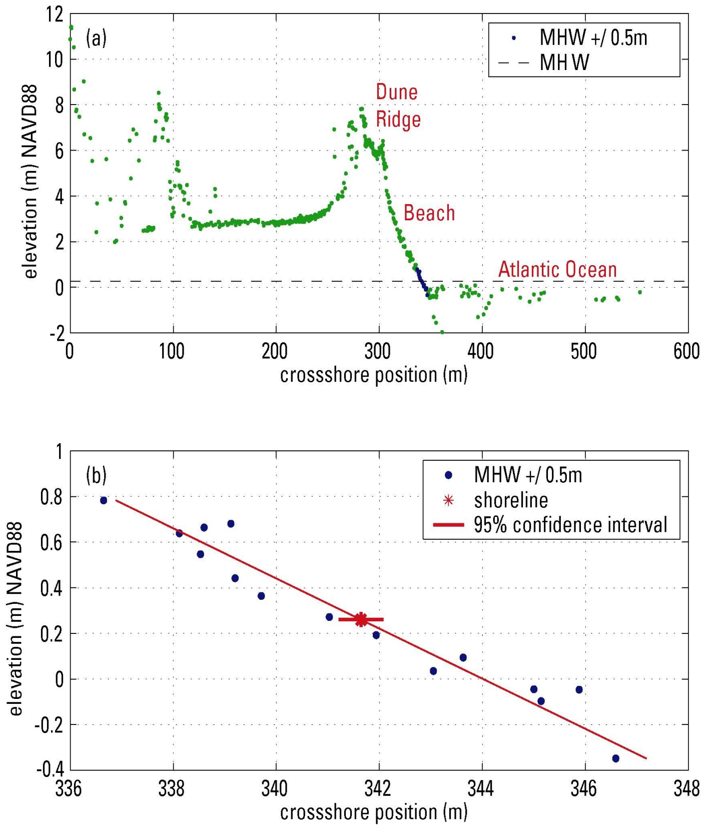
- Shorelines selected for 4 general time periods (1800s, 1920s-1930s, 1970s, post-1998).
- Existing data sets utilized, if available.
- Data gaps filled with historical T-sheets provided by NOAA.


Harrison's Pt.
De Soto Grove
Sister Sweet
G. & O. Quarterman
Duck Pt.
Home Pt.
Capt. Wilson's
Capt. Burnham Light Keeper
Wesson's
Sam Moore's
Moore's Pt.
Pelican I.
English's
Long Pt.
Ocean View Benj. Hall
Hall's Id.
Capt. Stone
BANANA RIVER
U.S. COAST SURVEY
Carlile P. Patterson Supdt.
CAPE CANAVERAL
AND
BANANA RIVER
FROM
Harrison's Pt. to Pelican Creek
FLORIDA
Surveyed under direction of
1877
Chas. Hosmer Assist.
By Joseph Hergesheimer
Sub Assistant
Register No 1450a.

Cape Canaveral, 1877

Methods: LIDAR shoreline

- Average MHW elevation determined from tide gages.
- Profiles at 20 meter spacing along coastline.
- Linear regression used to derive horizontal intersection of MHW datum with the profile.
- ‘Operational’ Mean High Water (MHW) shoreline extracted from LIDAR survey.



Stockdon et al., 2002

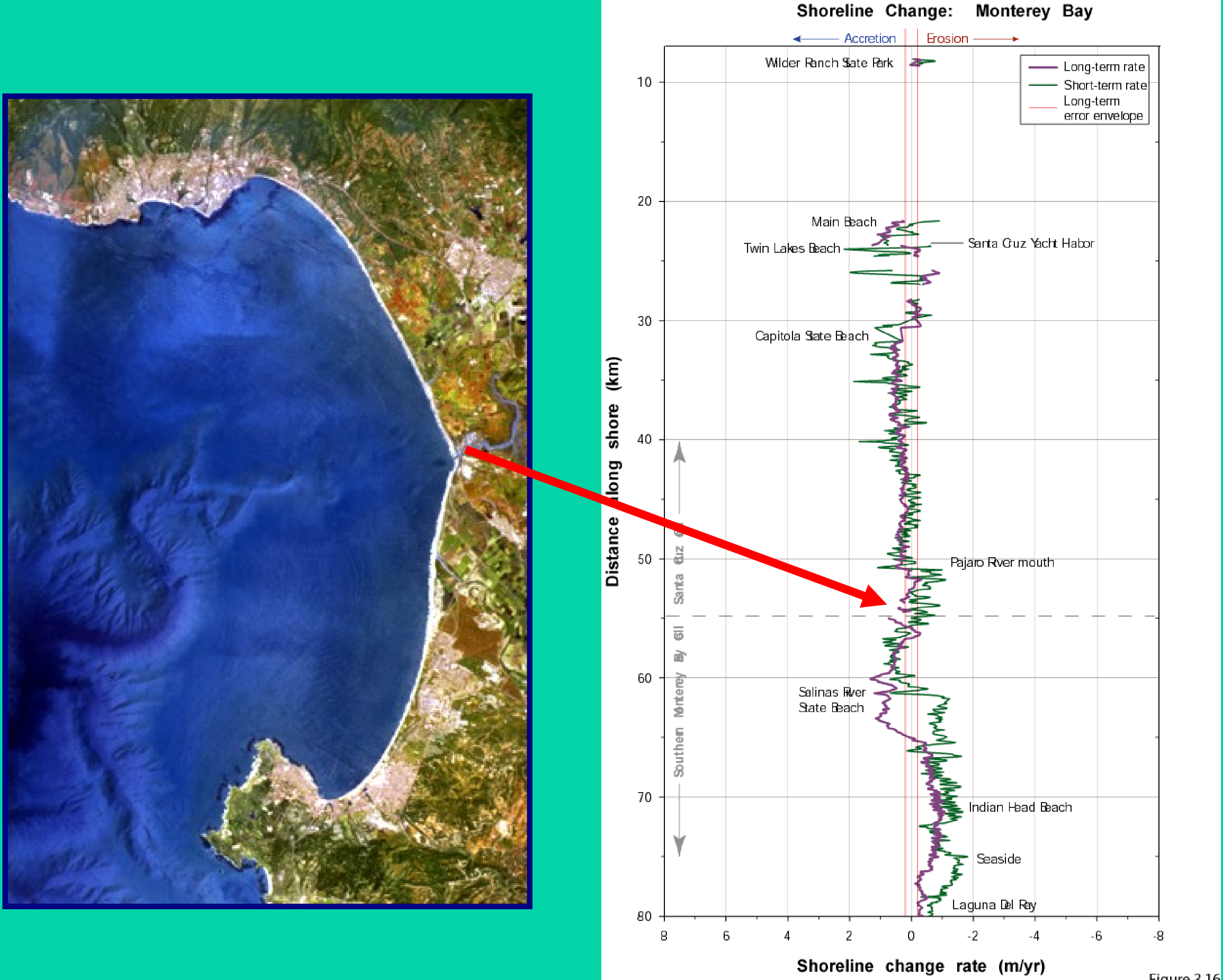
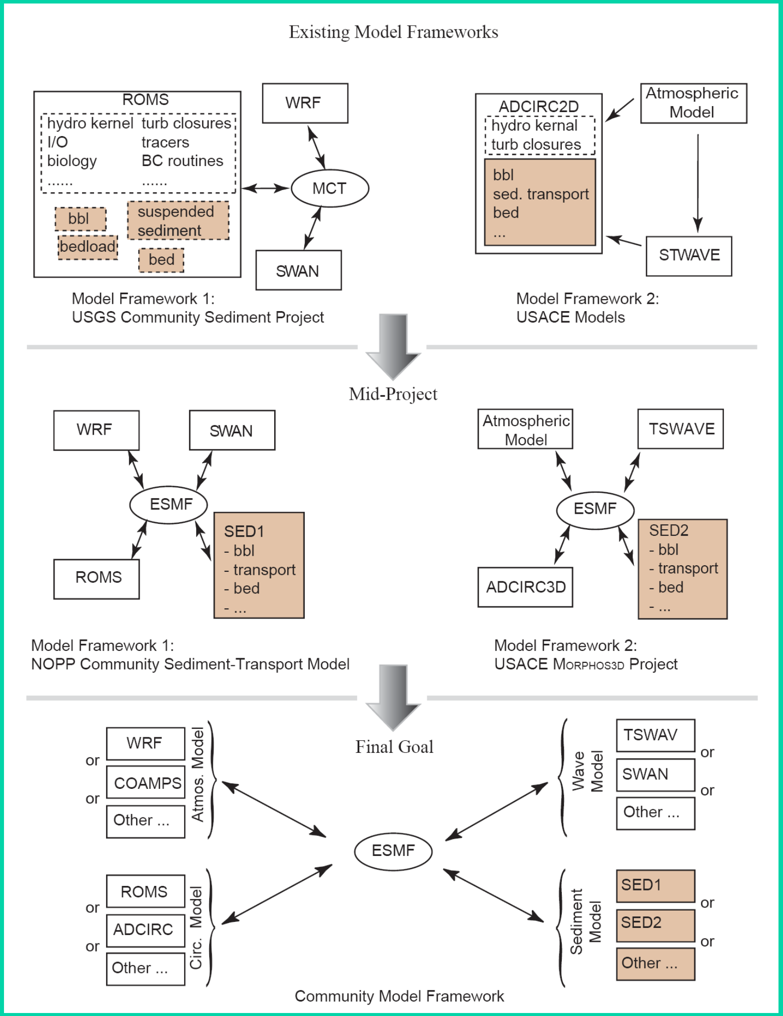

Shoreline Change: Monterey Bay
Accretion
Erosion
Long-term rate
Short-term rate
Long-term error envelope
Wilder Ranch State Park
Main Beach
Twin Lakes Beach
Santa Cruz Yacht Habor
Capitola State Beach
Pajaro River mouth
Salinas River State Beach
Indian Head Beach
Seaside
Laguna Del Ray
Santa Cruz Cell
Southern Monterey Bay Cell
Distance along shore (km)
10
20
30
40
50
60
70
80
Shoreline change rate (m/yr)
8
6
4
2
0
-2
-4
-6
-8

Figure 3.16

USGS – ERDC Collaboration on Community Sediment Transport Model

- Joint proposal to National Ocean Partnership Program ($3M+ / 3 years)
- Open-source coupled modeling project
- ERDC and USGS teams will collaborate on standards and conventions for model i/o and analysis tools
- ERDC and USGS models will be coupled at component level
- Common test cases and prototype applications



Existing Model Frameworks

ROMS
hydro kernel
I/O
biology
......
turb closures
tracers
BC routines
......
bbl
bedload
suspended sediment
bed
WRF
MCT
SWAN

Model Framework 1:
USGS Community Sediment Project

ADCIRC2D
hydro kernal
turb closures
bbl
sed. transport
bed
...
Atmospheric Model
STWAVE

Model Framework 2:
USACE Models

Mid-Project

WRF
SWAN
ESMF
ROMS
SED1
- bbl
- transport
- bed
- ...

Model Framework 1:
NOPP Community Sediment-Transport Model

Atmospheric Model
TSWAVE
ESMF
ADCIRC3D
SED2
- bbl
- transport
- bed
- ...

Model Framework 2:
USACE MORPHOS3D Project

Final Goal

Atmos. Model
WRF
or
COAMPS
or
Other ...

Circ. Model
ROMS
or
ADCIRC
or
Other ...

ESMF

Wave Model
TSWAV
or
SWAN
or
Other ...

Sediment Model
SED1
or
SED2
or
Other ...

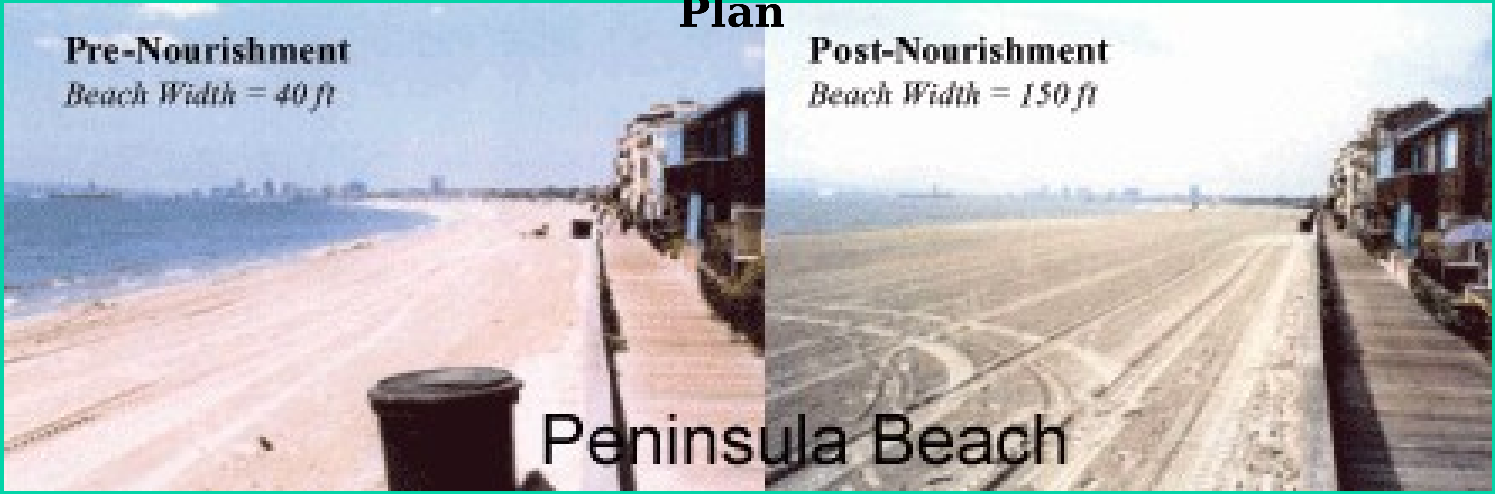
Community Model Framework

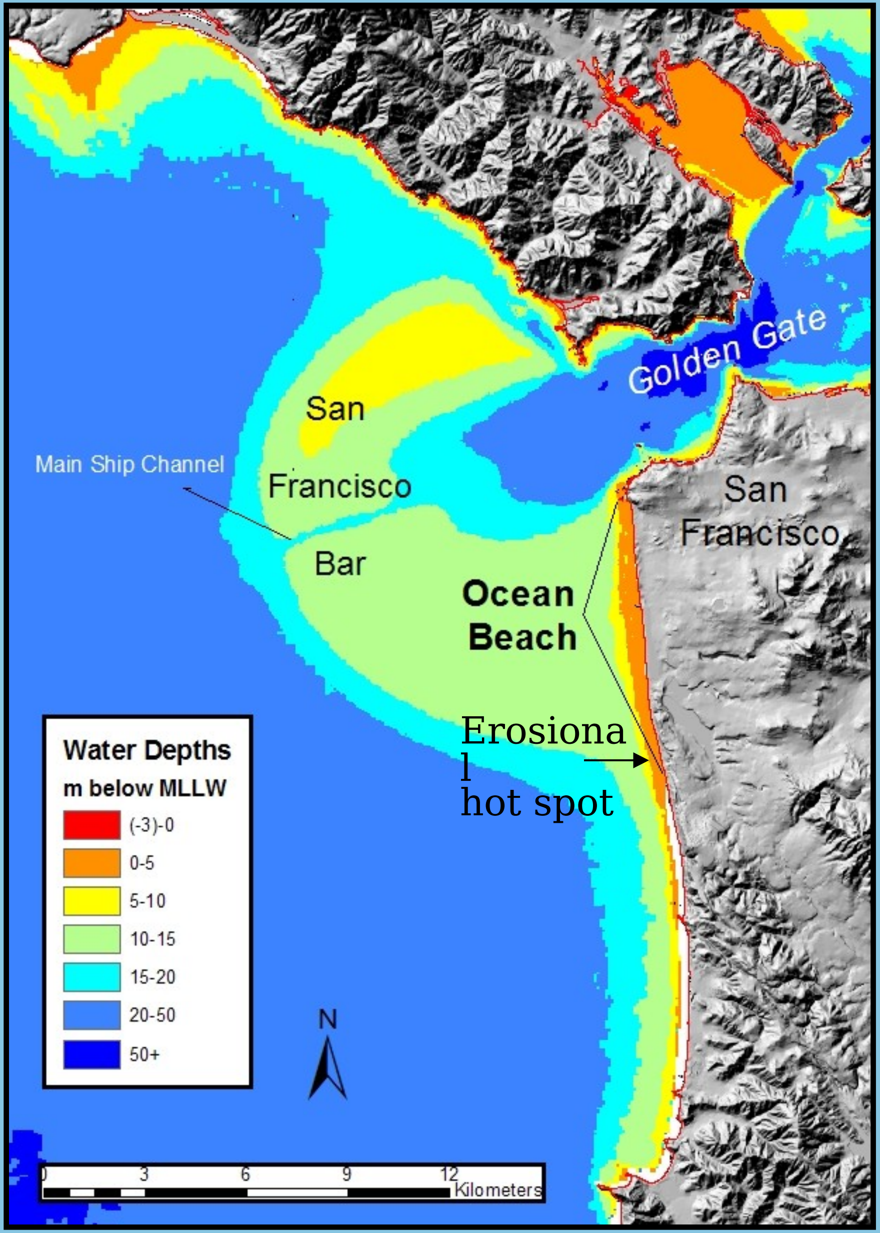
Coastal Sediment Management Workgroup

Executive leadership: CA Resources Agency, US AC

Partners: CA Boating and Waterways, CA Coastal Commission, CA Coastal Conservancy, CA State Parks, State Water Board & Regional Boards, CalTrans, CA DWR, CA Fish and Game, CA EPA, CA Geological Survey, ACE District & Division Offices, NOAA, USGS, US Fish & Wildlife, US EPA

Coastal Sediment Management Master Plan


Pre-Nourishment
Beach Width = 40 ft
Post-Nourishment
Beach Width = 150 ft
Peninsula Beach

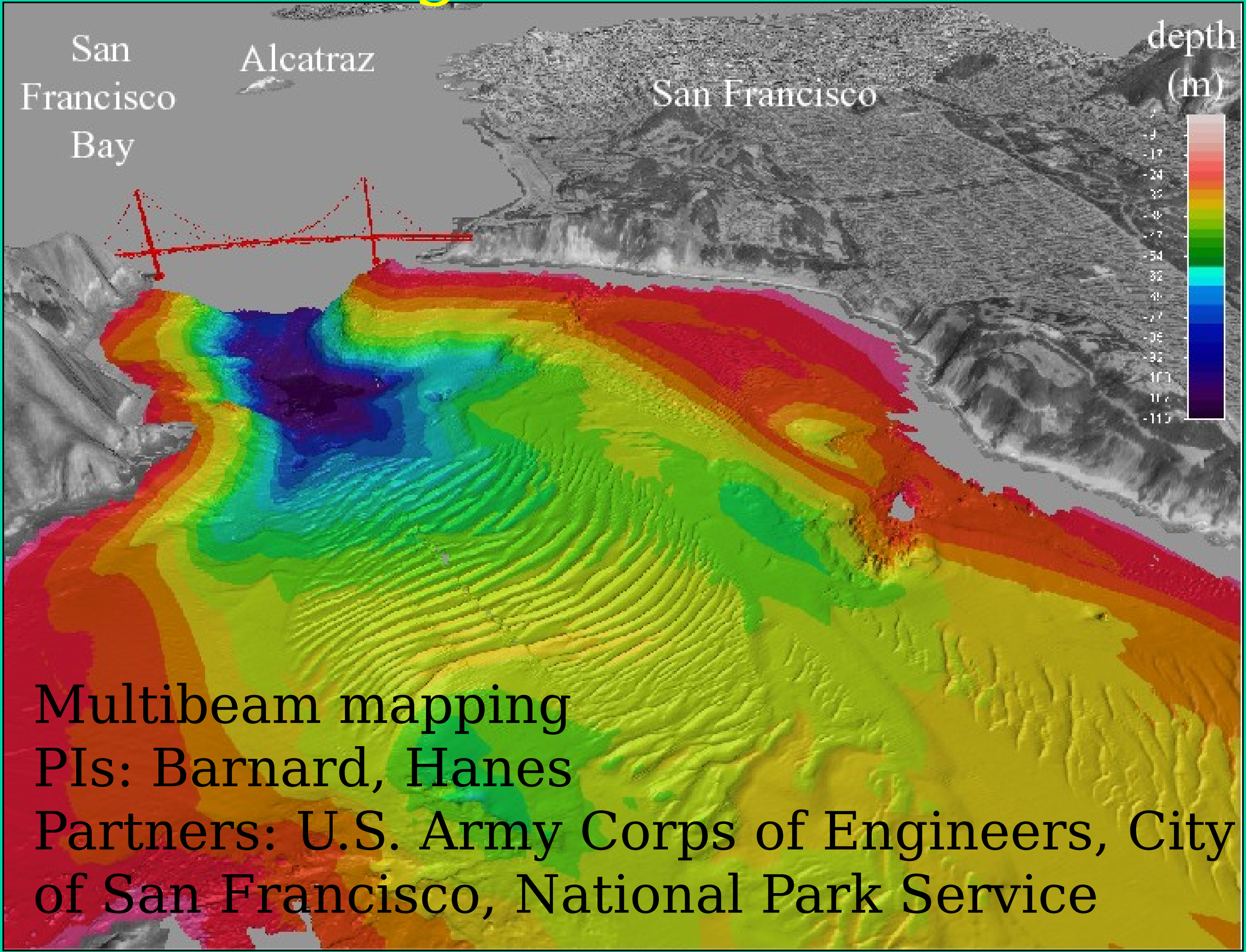

Golden Gate
San
Francisco
Bar
Main Ship Channel
San
Francisco
Ocean
Beach
Water Depths
m below MLLW
(-3)-0
0-5
5-10
10-15
15-20
20-50
50+
N
0
3
6
9
12
Kilometers

Erosional hot spot

- Hypothesis #1: The ebb tidal delta has shrunk in extent due to a reduced tidal prism- thereby altering wave refraction /focusing patterns and sediment transport pathways.

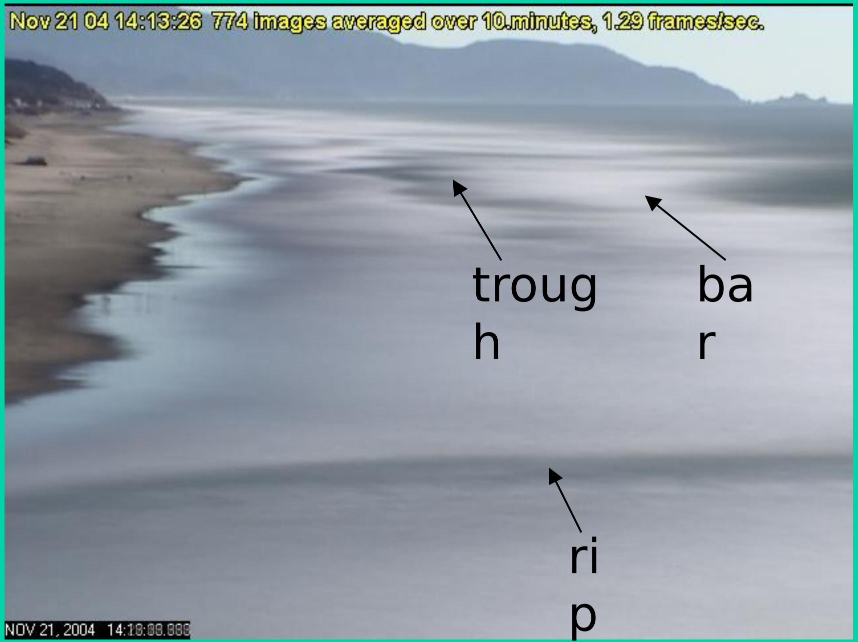
- Hypothesis #2: The system is sediment starved due to extensive damming coupled with a significant decrease in delta discharge

an Francisco Bight Coastal Processes St


San Francisco Bay
Alcatraz
San Francisco
depth (m)
-24
-54

Multibeam mapping
PIs: Barnard, Hanes
Partners: U.S. Army Corps of Engineers, City of San Francisco, National Park Service

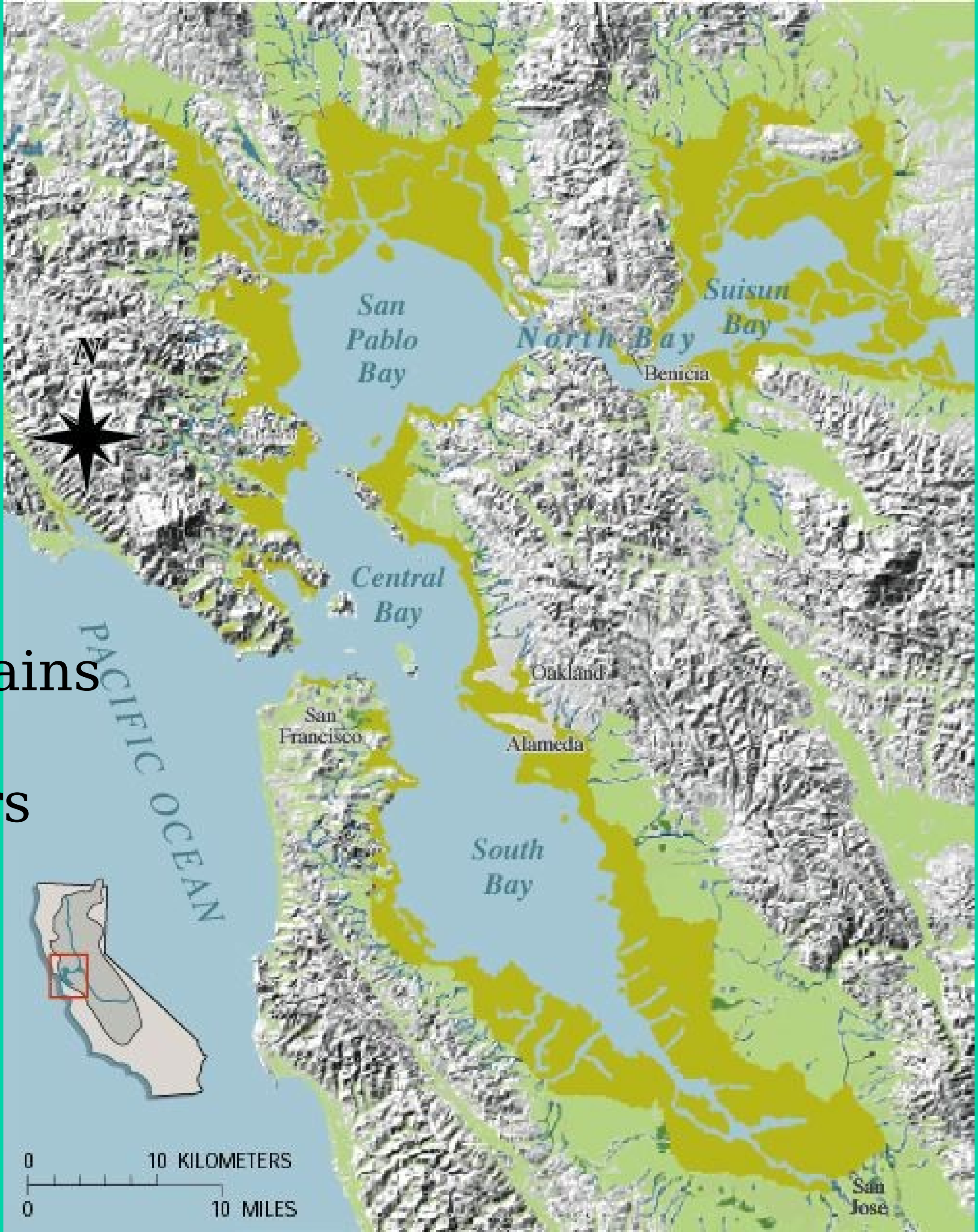
Ocean Beach Coastal Processes Study


Nov 21 04 14:13:26 774 images averaged over 10.minutes, 1.29 frames/sec.
trough
bar
rip
NOV 21, 2004 14:18:88.888

San Francisco Bay

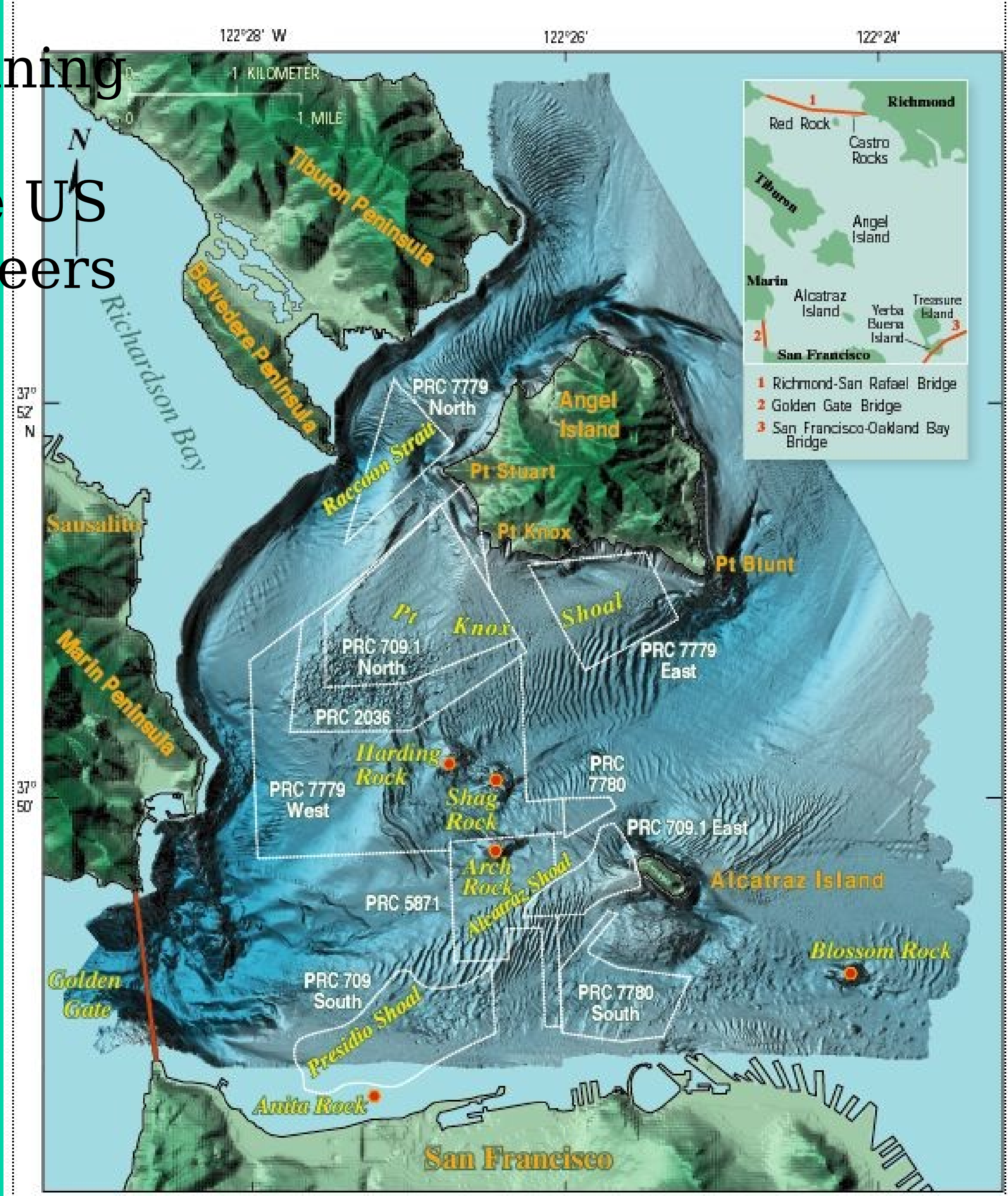
Informal Names
-North Bay
-Central Bay
-South Bay

Inset Map:
*Watershed that drains through SF Bay to Pacific Ocean covers 40% of California


N
San Pablo Bay
North Bay
Suisun Bay
Benicia
Central Bay
PACIFIC OCEAN
Oakland
San Francisco
Alameda
South Bay
San José
0
10 KILOMETERS
0
10 MILES

Present Day Sand Mining Lease Areas

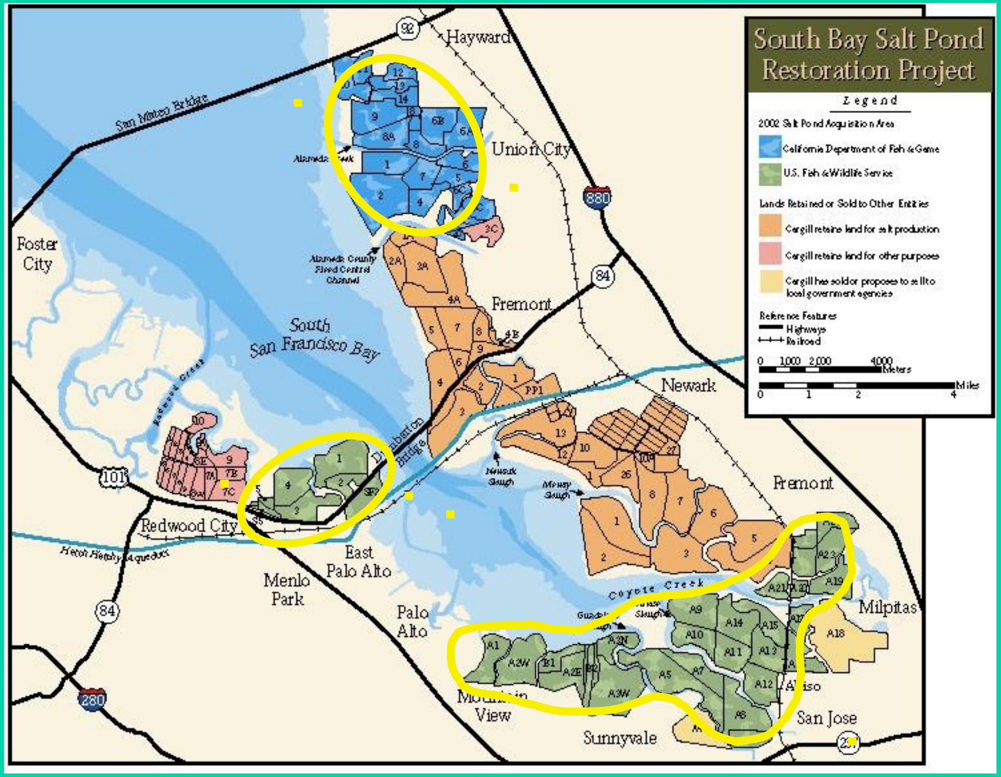
*Administered by the US Army Corps of Engineers and Cal. State Lands Commission


122°28' W
122°26'
122°24'
37° 52' N
37° 50'
0 1 KILOMETER
0 1 MILE
N
Tiburon Peninsula
Belvedere Peninsula
Richardson Bay
Raccoon Strait
PRC 7779 North
Angel Island
Pt Stuart
Pt Knox
Pt Blunt
Sausalito
Marin Peninsula
Pt Knox
Shoal
PRC 709.1 North
PRC 7779 East
PRC 2036
Harding Rock
Shag Rock
PRC 7780
PRC 7779 West
PRC 709.1 East
Arch Rock
Alcatraz Shoal
Alcatraz Island
PRC 5871
Blossom Rock
Golden Gate
PRC 709 South
Presidio Shoal
PRC 7780 South
Anita Rock
San Francisco
Richmond
Red Rock
Castro Rocks
Tiburon
Angel Island
Marin
Alcatraz Island
Yerba Buena Island
Treasure Island
San Francisco
1
2
3
1 Richmond-San Rafael Bridge
2 Golden Gate Bridge
3 San Francisco-Oakland Bay Bridge

15,000 acres of salt ponds to be restored in South San Francisco Bay

WCMG is part of a USGS project to fulfill short-term science needs for restoration planning

Project is funded by California State Coastal Conservancy, with matching of salary costs by WCMG

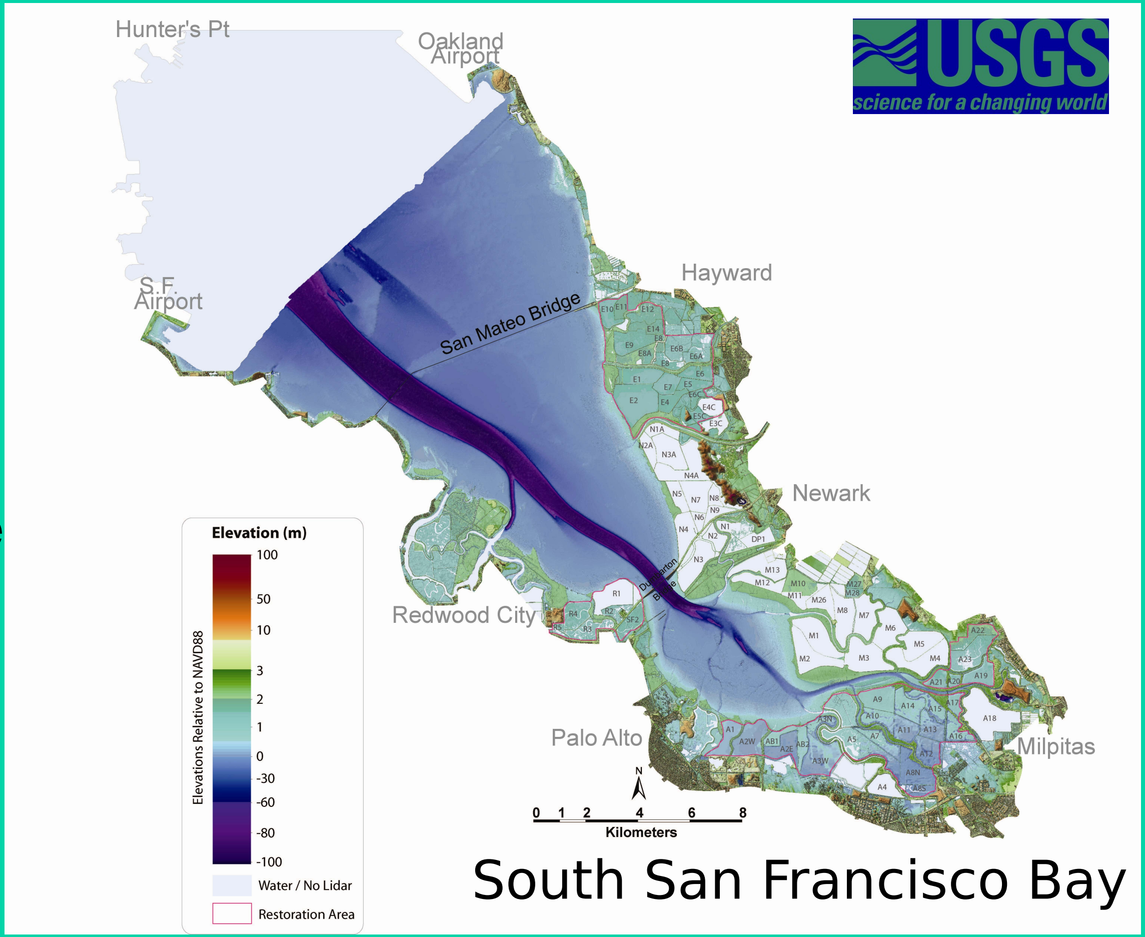

South Bay Salt Pond Restoration Project
Legend
2002 Salt Pond Acquisition Area
California Department of Fish & Game
U.S. Fish & Wildlife Service
Lands Retained or Sold to Other Entities
Cargill retains land for salt production
Cargill retains land for other purposes
Cargill has sold or proposes to sell to local government agencies
Reference Features
Highways
Railroad
0 1,000 2,000 4000 Meters
0 1 2 4 Miles
Hayward
San Mateo Bridge
Union City
Alameda Creek
Alameda County Flood Control Channel
Foster City
Fremont
South San Francisco Bay
Redwood Creek
Dumbarton Bridge
Newark
Newark Slough
Mowry Slough
Redwood City
Hetch Hetchy Aqueduct
East Palo Alto
Menlo Park
Palo Alto
Coyote Creek
Guadalupe Slough
Milpitas
Alviso
Mountain View
Sunnyvale
San Jose
92
880
84
101
280
237

(www.southbayrestoration.org)

Builds on WCMG SF-

USGS-USACE Data Sharing

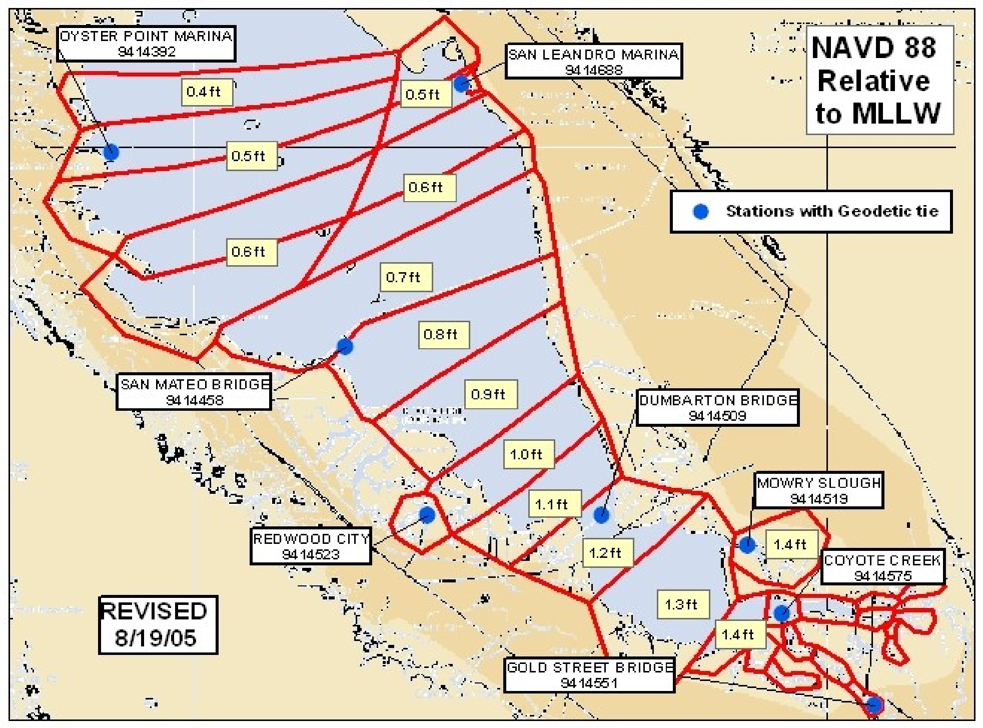
Lidar and bathymetry data collected for the USGS is being used in the USACE South San Francisco Bay Shoreline Study


Hunter's Pt
Oakland Airport
USGS
science for a changing world
S.F. Airport
Hayward
San Mateo Bridge
Newark
Redwood City
Dumbarton Bridge
Palo Alto
Milpitas
N
0 1 2 4 6 8
Kilometers
Elevation (m)
Elevations Relative to NAVD88
100
50
10
3
2
1
0
-30
-60
-80
-100
Water / No Lidar
Restoration Area
South San Francisco Bay

2004-2005 Merged Lidar and Bathymetry

USGS Collaboration with USACE and NOAA on Tidal Datums

WCMG and USACE SF District, together with NOAA, are establishing tidal datums that are critical for planning successful restoration

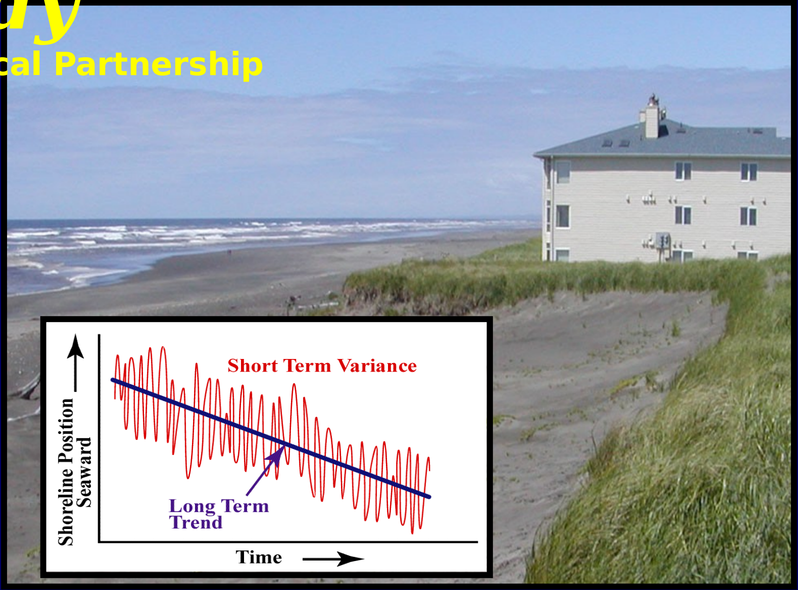

OYSTER POINT MARINA
9414392
SAN LEANDRO MARINA
9414688
NAVD 88
Relative
to MLLW
● Stations with Geodetic tie
0.4 ft
0.5 ft
0.5 ft
0.6 ft
0.6 ft
0.7 ft
0.8 ft
SAN MATEO BRIDGE
9414458
0.9 ft
DUMBARTON BRIDGE
9414509
1.0 ft
MOWRY SLOUGH
9414519
1.1 ft
REDWOOD CITY
9414523
1.2 ft
1.4 ft
COYOTE CREEK
9414575
REVISED
8/19/05
1.3 ft
1.4 ft
GOLD STREET BRIDGE
9414551

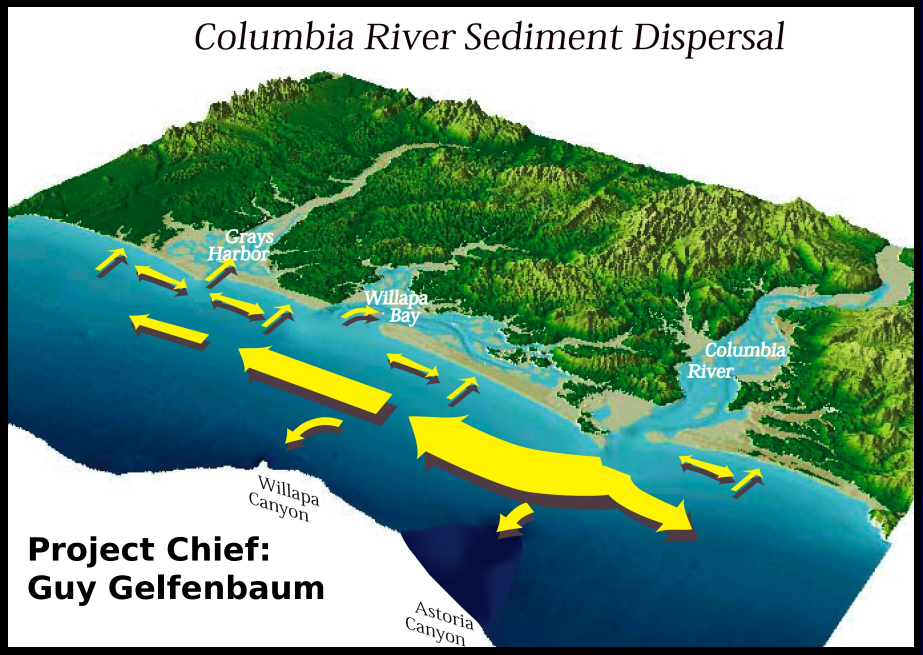
Conversion from NAVD 88 to MLLW;
Jerry Hovis, NOAA

Southwest Washington Coastal Erosion Study

A Federal-State-Local Partnership

- Understand regional coastal system dynamics
- Determine natural and human influences on coastal change
- Predict coastal change at management scales (yrs and km)

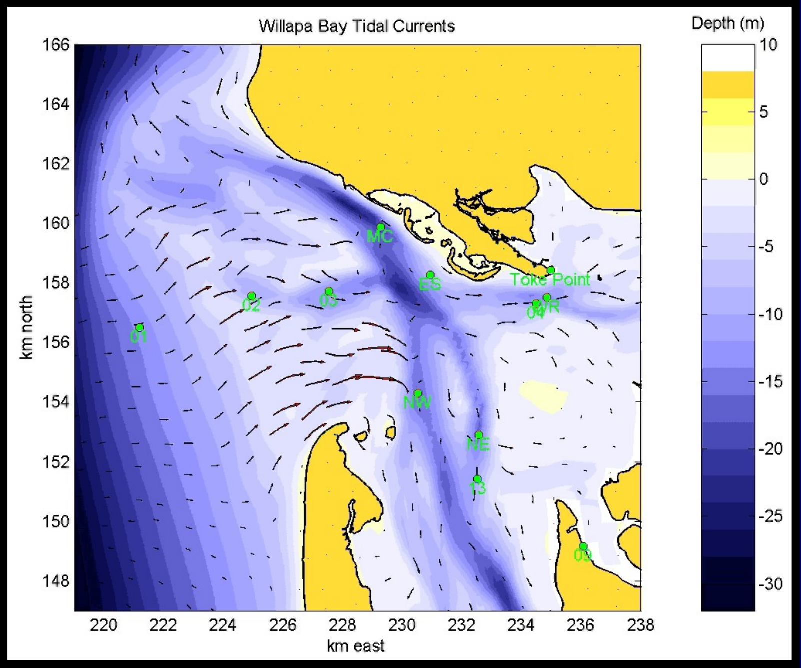




Columbia River Sediment Dispersal

Grays Harbor
Willapa Bay
Columbia River
Willapa Canyon
Astoria Canyon

Project Chief:
Guy Gelfenbaum


Willapa Bay Tidal Currents
Depth (m)
10
5
0
-5
-10
-15
-20
-25
-30
km north
166
164
162
160
158
156
154
152
150
148
km east
220
222
224
226
228
230
232
234
236
238
MC
ES
Toke Point
TR
04
03
02
01
NW
NE
13
09

Puget Sound Nearshore Ecosystem Restoration Project

A Federal, State, Local Partnership

OBJECTIVE:
Restoring and preserving nearshore processes of Puget Sound for the benefit of the biological resources and the integrity of the

A partnership of:

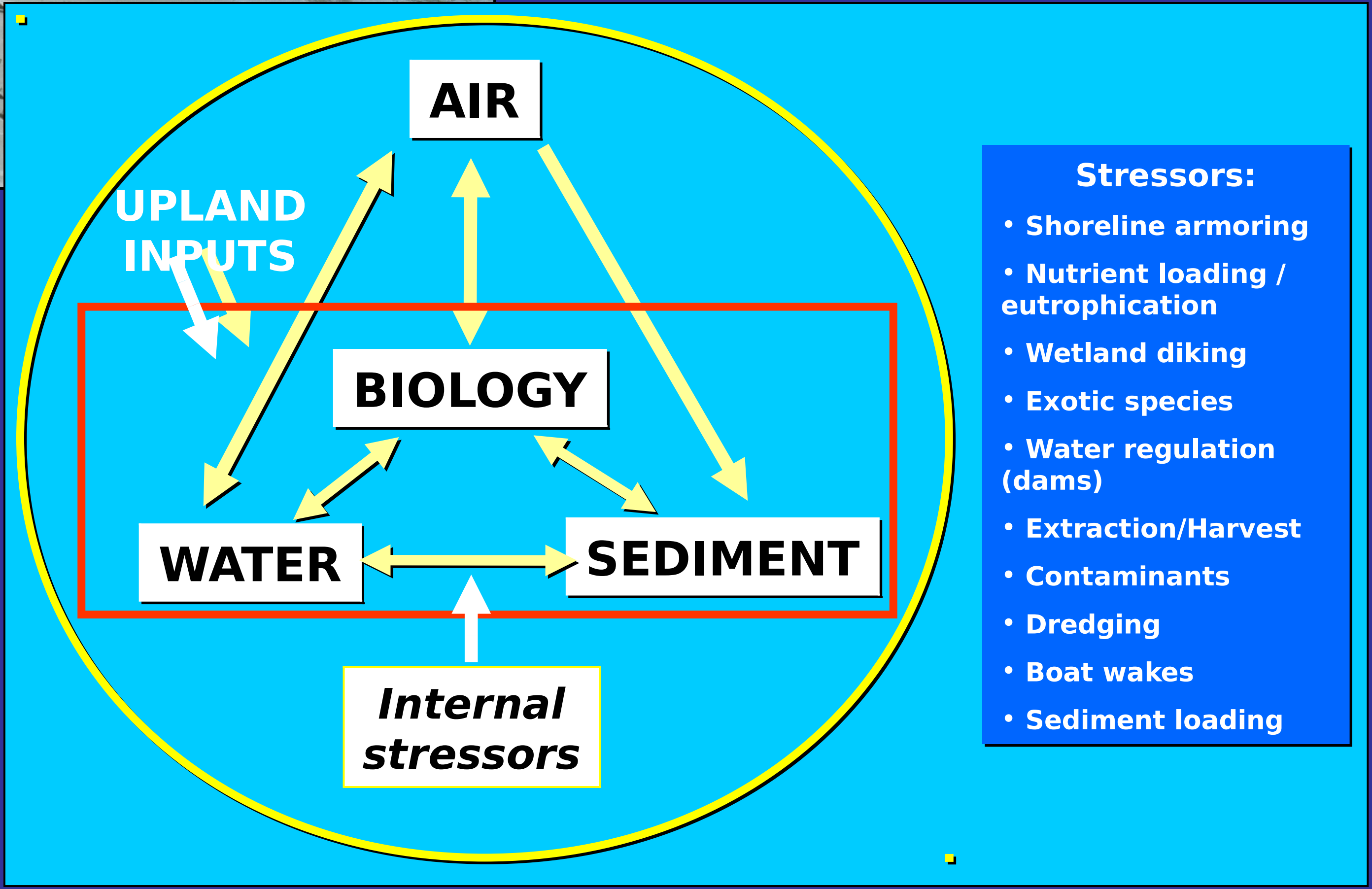
- U.S. Army Corps of Engineers
- Washington Dept of Fish and Wildlife
- US Geological Survey
- NOAA, National Marine Fisheries
- US Fish and Wildlife
- Washington State Agencies (DNR, Ecology)
- Tribes
- Local Governments
- Non-Governmental Organizations
- Academia

Photo courtesy of Michelle L. McConnell

Coastal Habitats in Puget Sound: *multi-disciplinary science to support restoration management*

Project Chief: Guy Gelfenbau

- **Geological processes and environmental reconstruction of major deltas: Skagit River delta**
- **Effects of Elwha Dam removal**
- **Beach and nearshore**



AIR

UPLAND INPUTS

BIOLOGY

WATER

SEDIMENT

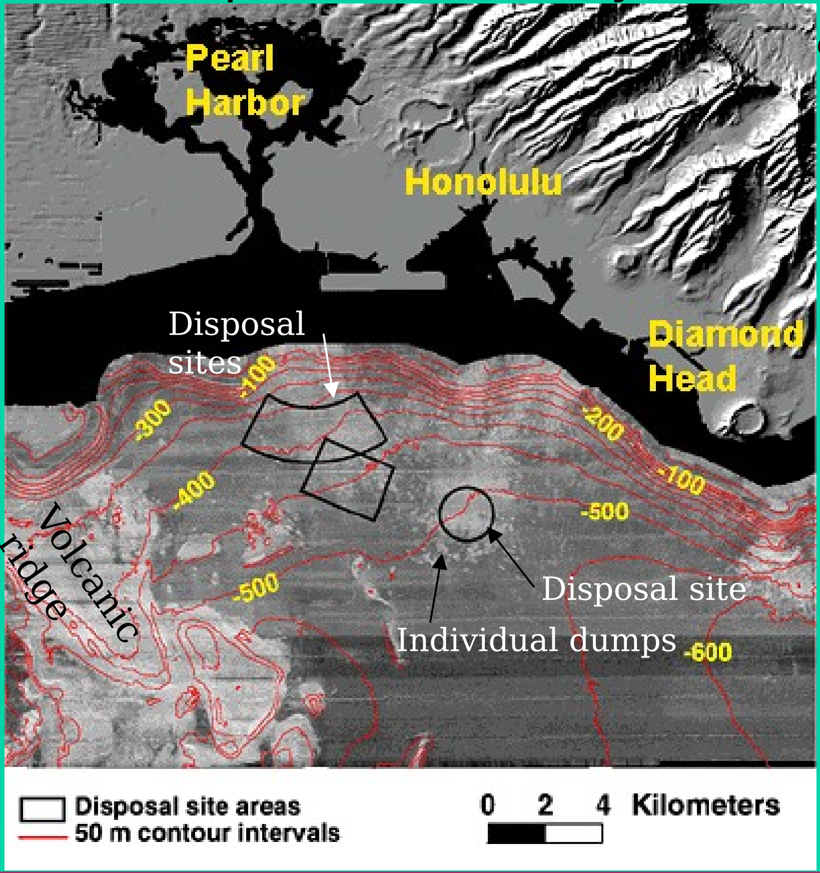
Internal stressors

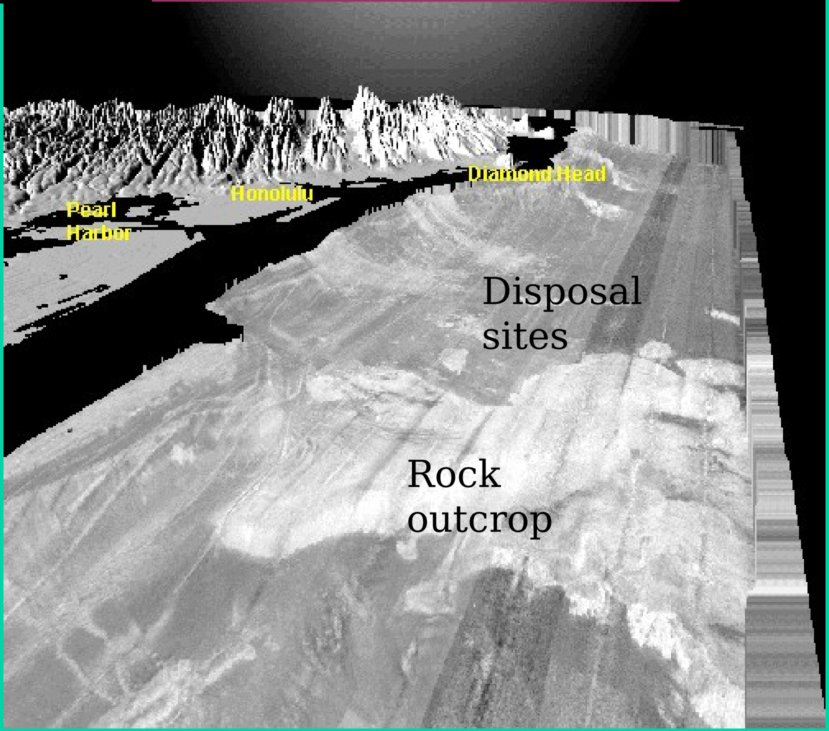
Stressors:

- **Shoreline armoring**
- **Nutrient loading / eutrophication**
- **Wetland diking**
- **Exotic species**
- **Water regulation (dams)**
- **Extraction/Harvest**
- **Contaminants**
- **Dredging**
- **Boat wakes**
- **Sediment loading**

Mapping of Dredge Disposal Site, Mamala Bay, Hawai'i

1. Sidescan sonar and multi-beam imaging were used to map offshore dredge disposal sites in Hawai'i to accurately determine their location and shape, and identify individual area.

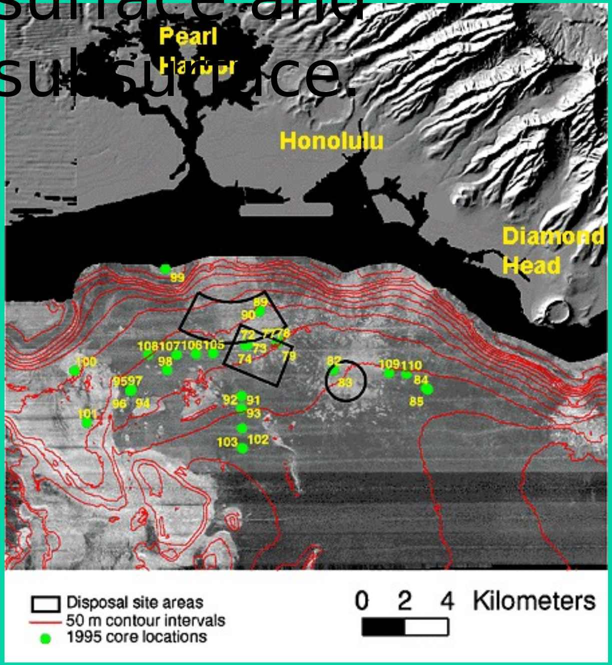

Pearl Harbor
Honolulu
Diamond Head
Disposal sites
Volcanic ridge
Disposal site
Individual dumps
-100
-200
-300
-400
-500
-600
Disposal site areas
50 m contour intervals
0 2 4 Kilometers


Pearl Harbor
Honolulu
Diamond Head
Disposal sites
Rock outcrop

3-D perspective

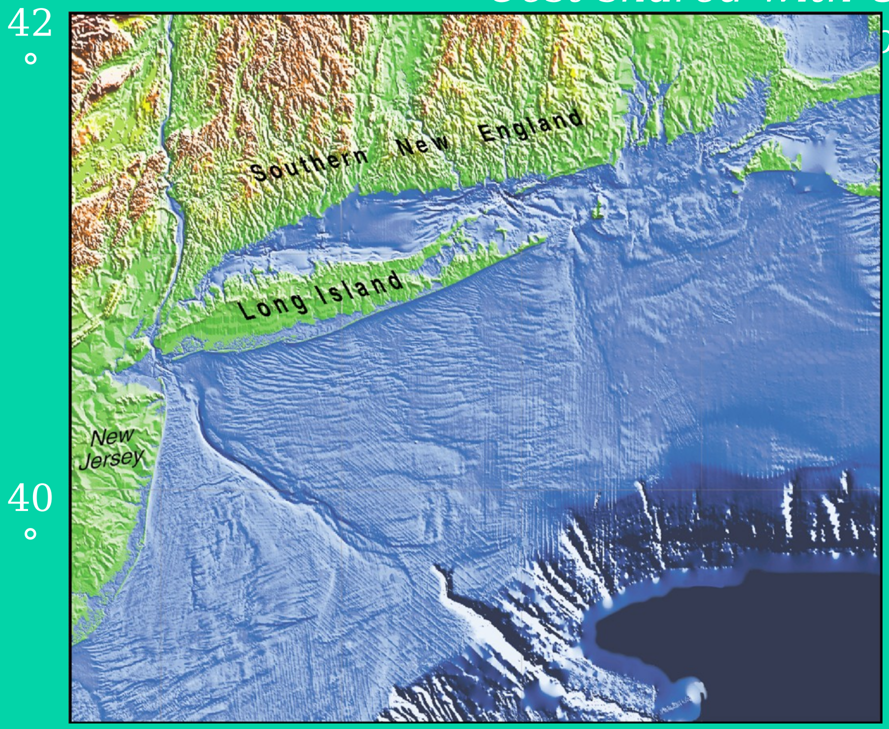
Mapping of Dredge Disposal Site, Mamala Bay, Hawai’i

2. Collection of box cores and bottom photographs were obtained to verify interpretation of acoustic images of the surface and subsurface.


Pearl Harbor
Honolulu
Diamond Head
99
89
90
108 107 106 105
72 77 78
73
74
79
98
100
95 97
96 94
92 91
93
103 102
101
82
83
109 110
84
85
Disposal site areas
50 m contour intervals
1995 core locations
0 2 4 Kilometers

New York Regional Studies

Cost-shared with U.S. Army Corps of
ork District

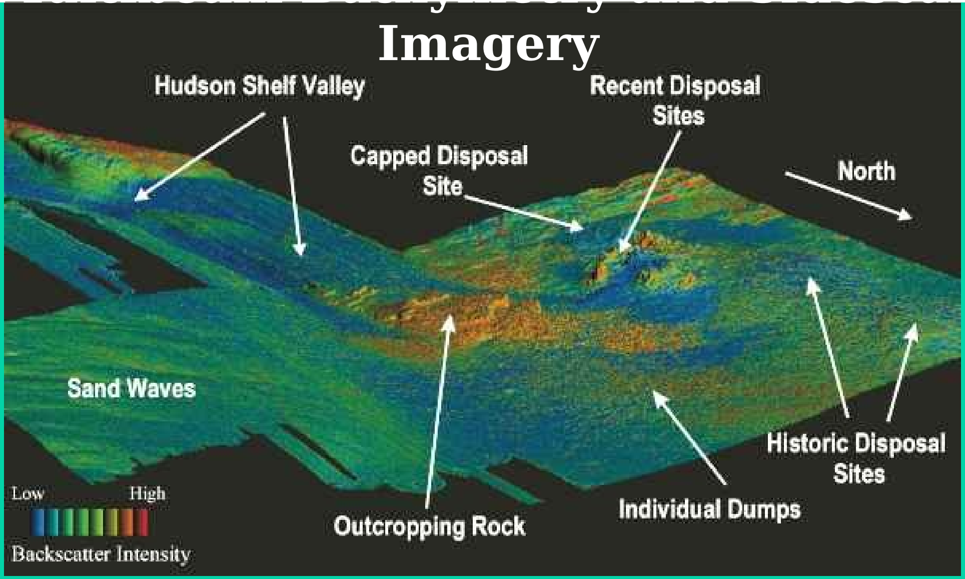

42°
Southern New England
Long Island
New Jersey
40°
74°
70°

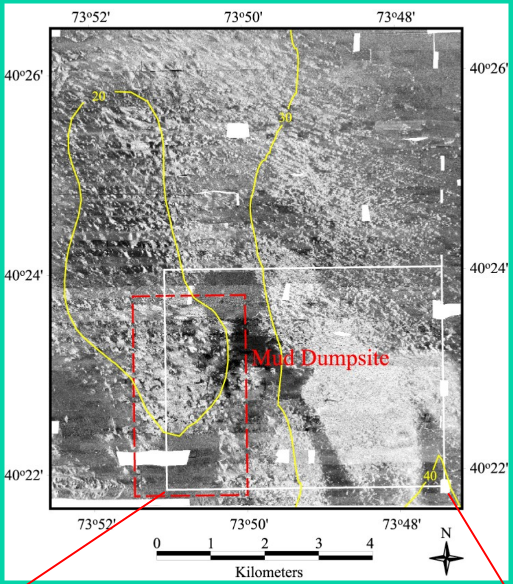
(From Uchupi et al., 2001)

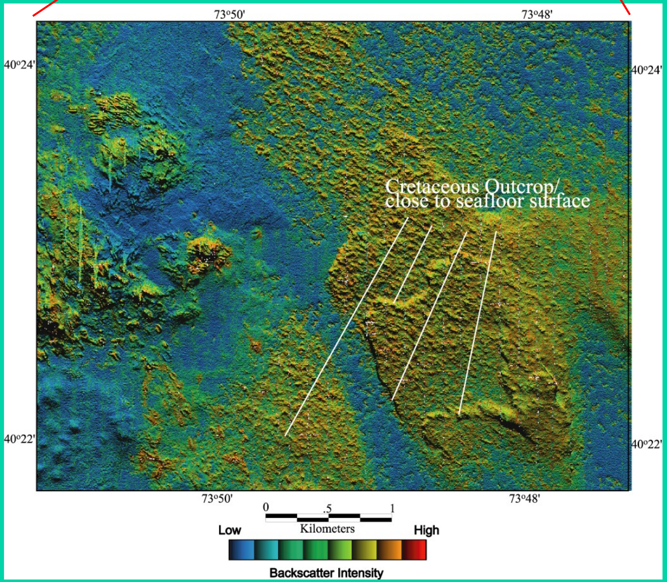
- Regional environmental impact of waste disposal
- Provide baseline information for planning for offshore disposal of dredge spoils
- Assessment of regional aggregate resources needed for coastal nourishment

NY—NJ Offshore Dumpsites

Multibeam Bathymetry and Sidescan Imagery

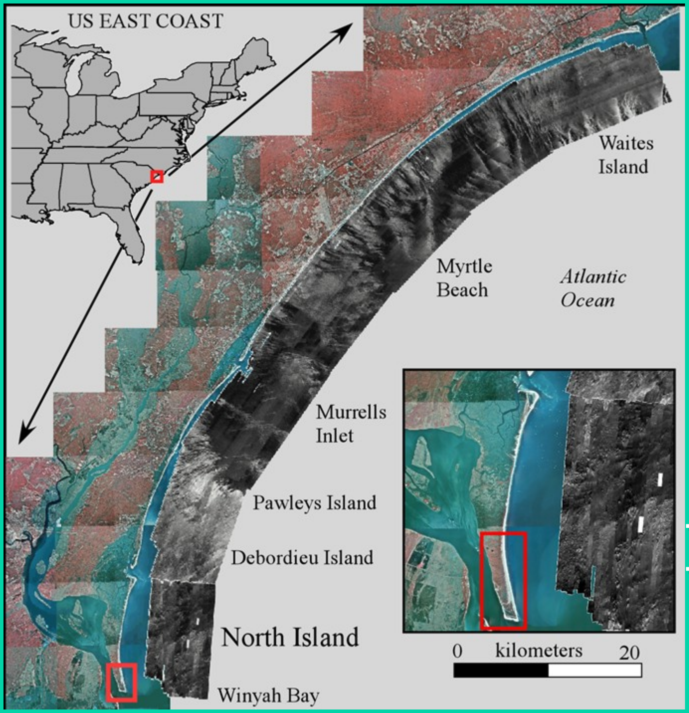

Hudson Shelf Valley
Recent Disposal Sites
Capped Disposal Site
North
Sand Waves
Historic Disposal Sites
Individual Dumps
Outcropping Rock
Low
High
Backscatter Intensity


73°52'
73°50'
73°48'
40°26'
40°24'
40°22'
20
30
40
Mud Dumpsite
0
1
2
3
4
Kilometers
N


73°50'
73°48'
40°24'
40°22'
Cretaceous Outcrop/
close to seafloor surface
0
.5
1
Kilometers
Low
High
Backscatter Intensity

USGS Coastal and Marine Geology Team

Woods Hole Field Center


US EAST COAST
Waites Island
Myrtle Beach
Atlantic Ocean
Murrells Inlet
Pawleys Island
Debordieu Island
North Island
Winyah Bay
0
kilometers
20

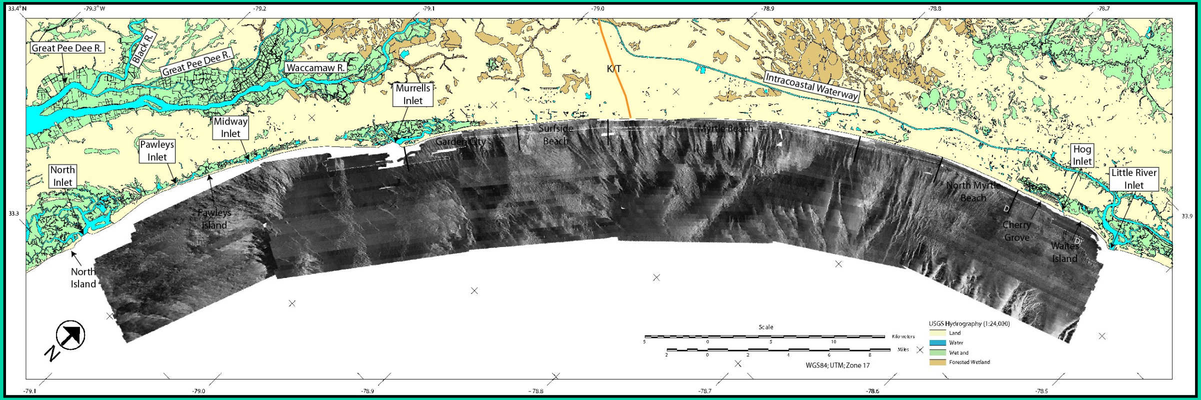
South Carolina Coastal Erosion Project

Continental Shelf Geologic Framework, Marine Transgression, and the Evolution of the Coastal System

William C. Schwab (USGS)

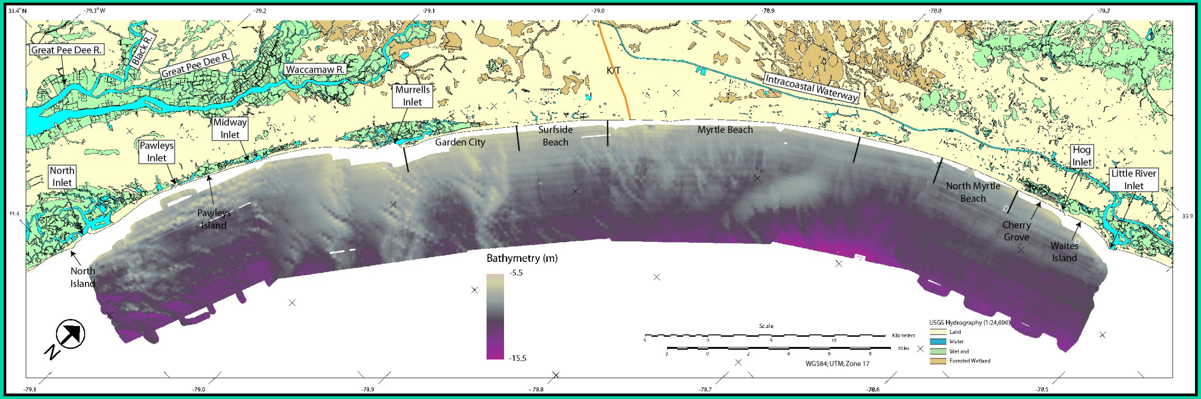
100 kHz Sidescan-sonar mosaic

- ~ 700 km² area


Great Pee Dee R.
Black R.
Great Pee Dee R.
Waccamaw R.
Murrells Inlet
K/T
Intracoastal Waterway
Midway Inlet
Pawleys Inlet
Garden City
Surfside Beach
Myrtle Beach
Hog Inlet
Little River Inlet
North Inlet
Pawleys Island
North Myrtle Beach
Cherry Grove
Waites Island
North Island
N
Scale
Kilometers
Miles
WGS84; UTM; Zone 17
USGS Hydrography (1:24,000)
Land
Water
Wetland
Forested Wetland

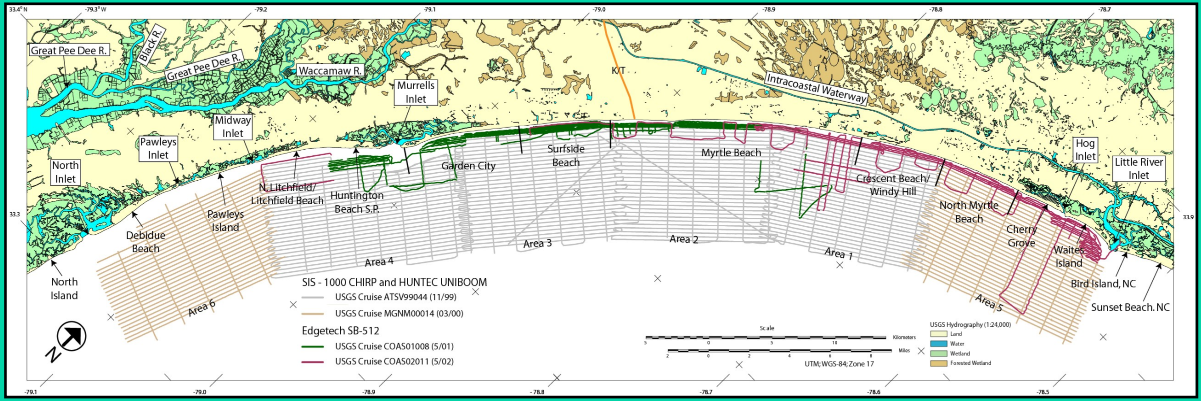
Interferrometric sonar bathymetry grid

- ~ 700 km² area

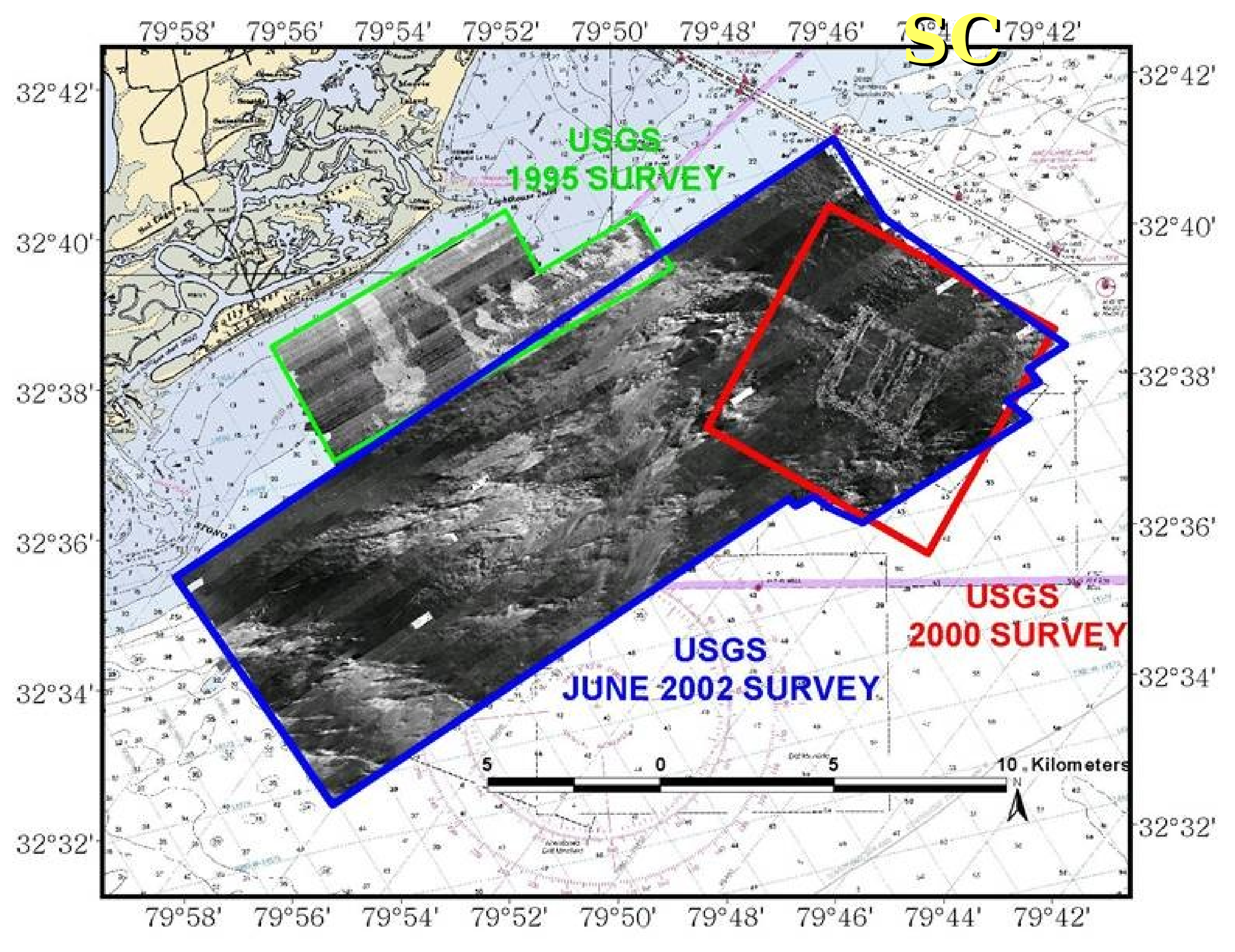

Great Pee Dee R.
Black R.
Great Pee Dee R.
Waccamaw R.
Murrells Inlet
K/T
Intracoastal Waterway
Midway Inlet
Pawleys Inlet
Garden City
Surfside Beach
Myrtle Beach
Hog Inlet
Little River Inlet
North Inlet
Pawleys Island
North Myrtle Beach
Cherry Grove
Waites Island
North Island
Bathymetry (m)
-5.5
-15.5
N
Scale
Kilometers
Miles
WGS84; UTM; Zone 17
USGS Hydrography (1:24,000)
Land
Water
Wetland
Forested Wetland

Seismic reflection

- ~ 2700 trackline km coincident SIS-1000 CHIRP and Huntech Boomer
- ~ 600 trackline km SB-512 CHIRP

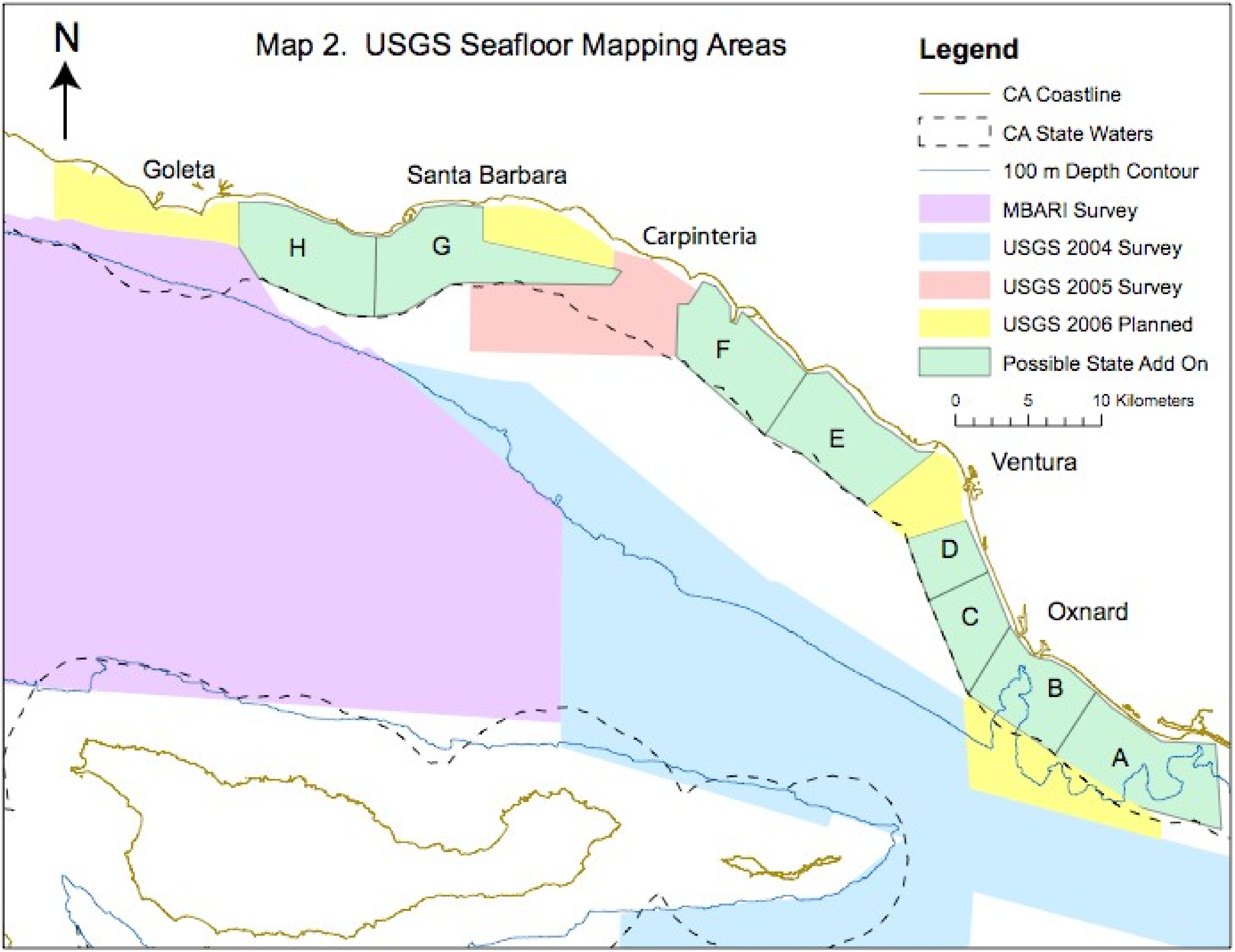

Great Pee Dee R.
Black R.
Great Pee Dee R.
Waccamaw R.
Murrells Inlet
K/T
Intracoastal Waterway
Midway Inlet
Pawleys Inlet
North Inlet
Garden City
Surfside Beach
Myrtle Beach
Hog Inlet
Little River Inlet
N. Litchfield/ Litchfield Beach
Huntington Beach S.P.
Crescent Beach/ Windy Hill
North Myrtle Beach
Cherry Grove
Waites Island
Bird Island, NC
Sunset Beach, NC
Pawleys Island
Debidue Beach
North Island
Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
SIS - 1000 CHIRP and HUNTEC UNIBOOM
USGS Cruise ATSV99044 (11/99)
USGS Cruise MGNM00014 (03/00)
Edgetech SB-512
USGS Cruise COAS01008 (5/01)
USGS Cruise COAS02011 (5/02)
N
Scale
Kilometers
Miles
UTM; WGS-84; Zone 17
USGS Hydrography (1:24,000)
Land
Water
Wetland
Forested Wetland

PHASE I –Central SC


79°58'
79°56'
79°54'
79°52'
79°50'
79°48'
79°46'
79°44'
79°42'
32°42'
32°40'
32°38'
32°36'
32°34'
32°32'
USGS 1995 SURVEY
USGS 2000 SURVEY
USGS JUNE 2002 SURVEY
5
0
5
10 Kilometers
N

Summary

ACE and USGS Coastal and Marine Geology Program have complementary missions and are successfully collaborating on several important efforts - at both a national and regional scale.



Map 2. USGS Seafloor Mapping Areas

N
Legend
CA Coastline
CA State Waters
100 m Depth Contour
MBARI Survey
USGS 2004 Survey
USGS 2005 Survey
USGS 2006 Planned
Possible State Add On
0
5
10 Kilometers
Goleta
Santa Barbara
Carpinteria
Ventura
Oxnard
H
G
F
E
D
C
B
A

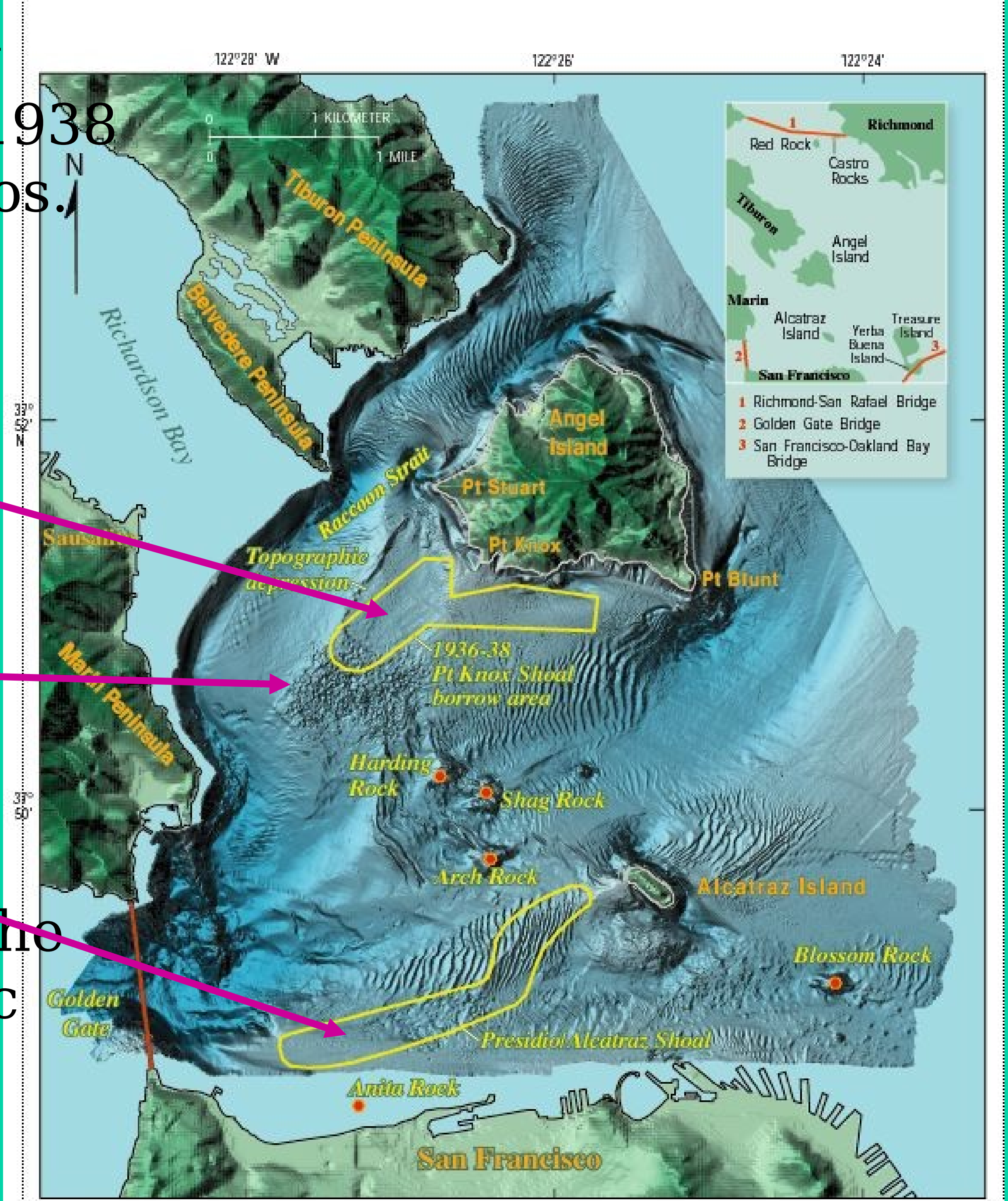
Issues addressed by mapping - Santa Barbara Channel

- Benthic habitats, marine protected areas
- **Coastal erosion and sediment management**
- **Sediment and contaminant budgets and transp**
- **Matilija Dam removal**
- Offshore infrastructure (platforms, pipelines, LNG, e
- Tsunami hazards
- Earthquake hazards
- Oil seeps

Coastal Change in the Urban Ocean- Santa Barbara and Ventura Counties

Partners: CA Boating and Waterways,
BEACON , City of Carpinteria,
NPS, US ACOE

Sand Mining Borrow Areas used in 1936-1938 for Golden Gate Expos. (Treasure Island)

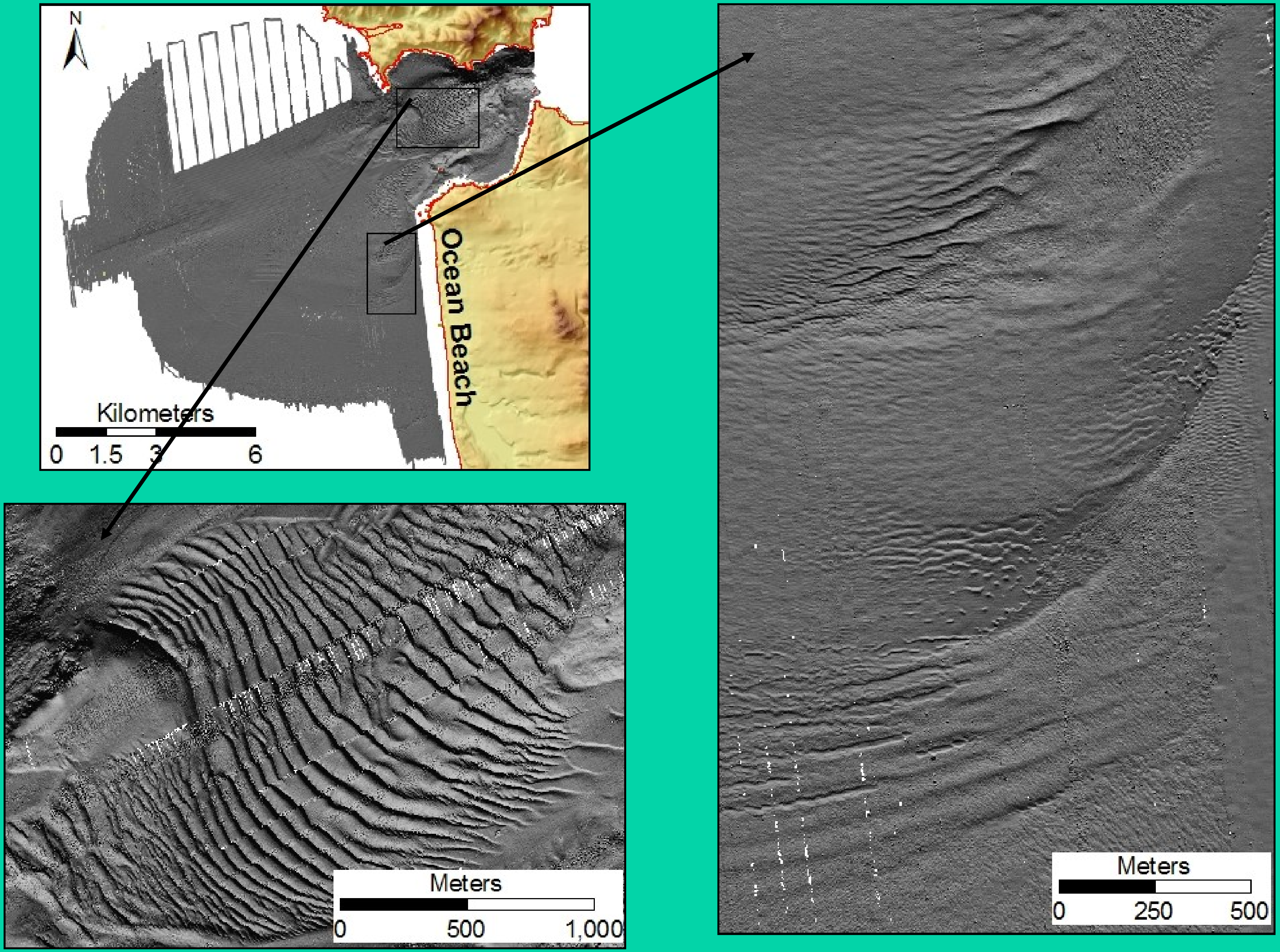

122°28' W
122°26'
122°24'
0
1 KILOMETER
0
1 MILE
N
37°
52'
N
37°
50'
Tiburon Peninsula
Belvedere Peninsula
Richardson Bay
Raccoon Strait
Angel Island
Pt Stuart
Pt Knox
Pt Blunt
Sausalito
Topographic depression
1936-38 Pt Knox Shoal borrow area
Marin Peninsula
Harding Rock
Shag Rock
Arch Rock
Alcatraz Island
Blossom Rock
Golden Gate
Presidio/Alcatraz Shoal
Anita Rock
San Francisco
Richmond
Red Rock
Castro Rocks
Tiburon
Angel Island
Marin
Alcatraz Island
Yerba Buena Island
Treasure Island
San Francisco
1
2
3
1 Richmond-San Rafael Bridge
2 Golden Gate Bridge
3 San Francisco-Oakland Bay Bridge

*depression in Point Knox Shoal coincides with the borrow area

*disrupted area

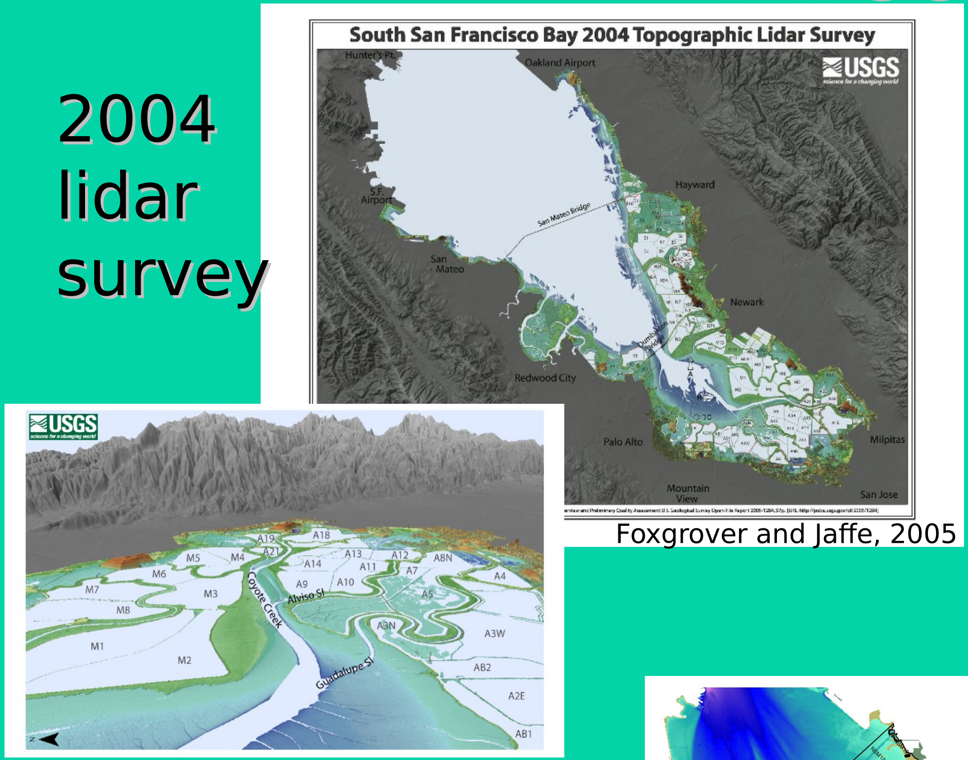
*The borrow area on Presidio Shoal was previously used for the 1915 Panama- Pacific Exposition

Multibeam Survey- October 2004

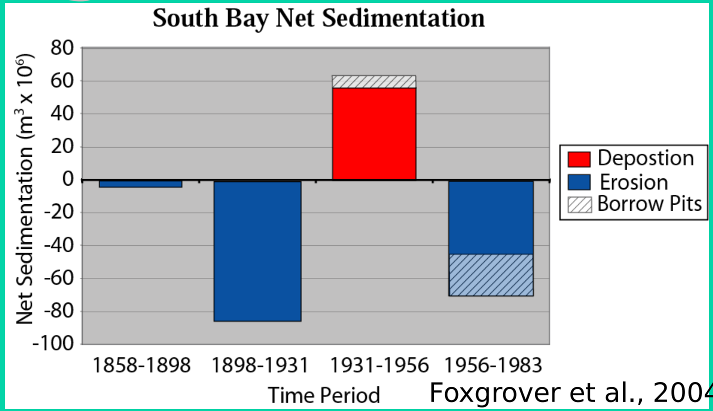

N
Ocean Beach
Kilometers
0
1.5
3
6
Meters
0
500
1,000
Meters
0
250
500

CMGP Salt Pond Project Accomplishments and Future Directions

2004 lidar survey


South San Francisco Bay 2004 Topographic Lidar Survey
USGS
Hunter's Pt.
Oakland Airport
S.F. Airport
San Mateo Bridge
Hayward
San Mateo
Newark
Dumbarton Bridge
Redwood City
Palo Alto
Mountain View
Milpitas
San Jose
A19
A18
A21
M5
M4
A13
A12
A8N
M6
A14
A11
A7
A4
M7
M3
A9
A10
Alviso Sl
A5
M8
Coyote Creek
A3N
A3W
M1
M2
Guadalupe Sl
AB2
A2E
AB1

Foxgrover and Jaffe, 2005



Foxgrover et al., 2004

historical sediment budget

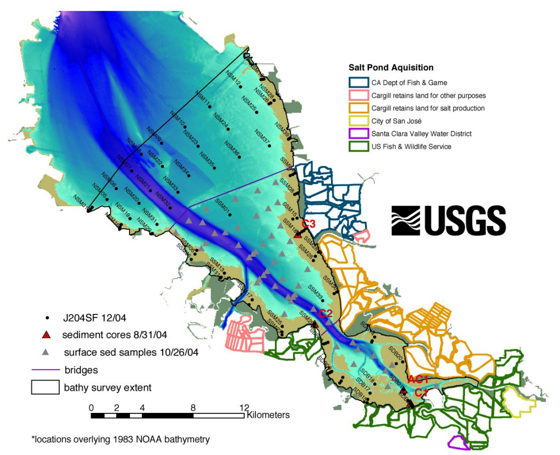
Future Directions

- sediment properties
- revise sed. budget

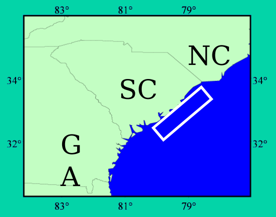
Goal

Improve prediction of

2005 bathymetry survey, sediment sampling, acoustic seabed classificati


Salt Pond Aquisition
CA Dept of Fish & Game
Cargill retains land for other purposes
Cargill retains land for salt production
City of San José
Santa Clara Valley Water District
US Fish & Wildlife Service
USGS
C3
C2
AC1
C1
J204SF 12/04
sediment cores 8/31/04
surface sed samples 10/26/04
bridges
bathy survey extent
0
2
4
8
12
Kilometers
*locations overlying 1983 NOAA bathymetry

A 680 km² region off northern South Carolina mapped in ~9 weeks as baseline information for “C


83°
81°
79°
NC
SC
G
A
34°
32°
34°
32°
83°
81°
79°